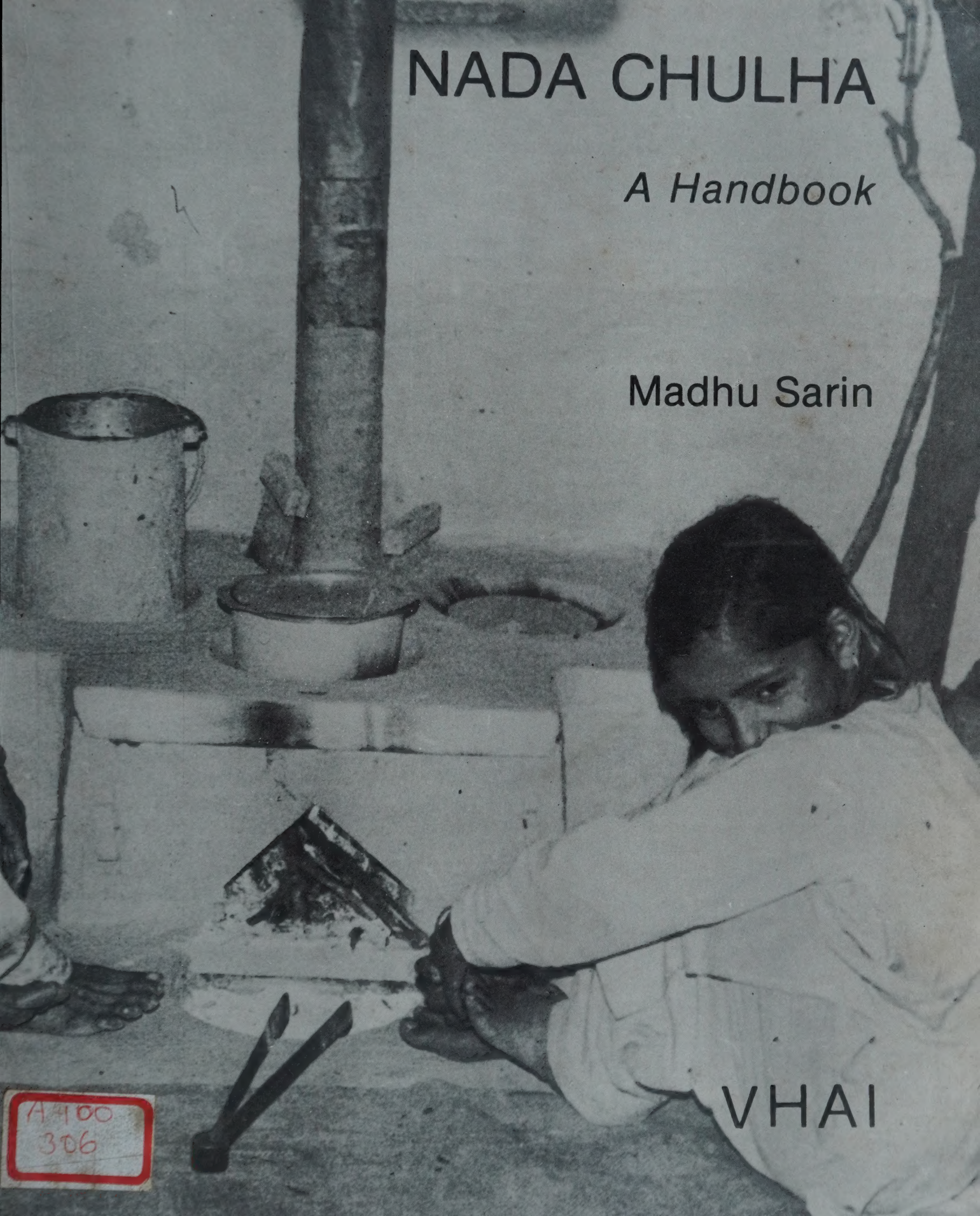
NADA CHULHA

A Handbook

Madhu Sarin



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Who this handbook is for

This handbook has been specially prepared for use by workers involved in spreading the improved chulha of the fixed type. This includes chulha project co-ordinators, supervisors and trainers of chulha mistris. The handbook can also be used by individuals or organisations interested in doing their own experiments.

How to use this handbook

The handbook has seven chapters and an appendix as given in the table of contents. Each chapter is quite self-contained and begins with instructions to trainers. The instructions have been put in a box to make it easy to find them. They tell how trainers can use the chapter during a training course. The appendix gives the outline for a 10 day training course for chulha mistris.

Chapters I, II and III are more general and should be read by all trainers, chulha project co-ordinators and supervisors.

Chapters IV, V, VI and VII tell how to build the chulha, how to plan chulhas for different needs, how to use and maintain the chulha and how to solve common problems of users. Each of these can be referred to separately as and when necessary.

The handbook should not be used as a recipe book or a do-it-yourself manual. Its use should be accompanied by training. We hope that it will help field workers make the chulha more useful to women with different needs and circumstances.

COMMUNITY HEALTH CELL
47/1 St. Mark's Road, Bangalore

NADA CHULHA

A Handbook

Madhu Sarin

Illustrations Jolly Rohatgi
Amba Sanyal
Madhu Sarin

Photographs : Madhu Sarin

Voluntary Health Association of India

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This handbook is available in Hindi also.

Companion publications include:

1. How to make and use the Nada Chulha (Hindi and English)
2. How to make best use of the Nada Chulha (poster in Hindi).
3. Why should you adopt the Nada Chulha? (promotional poster in Hindi).

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This book is dedicated to the women of Nada village in Haryana who have actively participated in the development of the chulha and after whom the chulha is named

.....and to village women in several parts of India with whom and from whom we continue to learn.

Request for your comments,
criticisms and ideas:

This book is only a beginning. We want to improve it - with your help.

If you have any suggestions on improving it, either in content or form, please send them to us.

Please let us know which parts of the book you find most useful, and which parts, pages, paragraphs, pictures or diagrams you find confusing, badly written, least useful or incorrect.

We are especially interested in receiving suggestions from village and community workers who have become chulha project supervisors and instructors.

Please write to:

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ACKNOWLEDGEMENTS

This handbook is the outcome of a long, co-operative effort. It is hardly possible to name all the individuals and organisations who have contributed to it directly or indirectly here. However, to the following I would like to express my special gratitude:

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To Khajani, Urmila Sharma, Munna Devi, Sarla, Kalawati, Suman, Savita and Santosh of the Haryana SWRC, Khori for bringing the concept of the village woman chulha mistri to life. Under Sunder Lal's able guidance, they have shown that village women can take the technology to other village women.

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INTRODUCTION

1. WHY THIS HANDBOOK?

It has become clear that an improved chulha can help women improve their daily lives very much. Whenever it has been introduced with care, demand for the chulha has been more than the supply. A big problem has been the few trained mistris and supervisors available. The organisational problems of taking chulhas to remote village homes and making sure that they work properly are also not understood.

Chulhas built by badly trained workers who do not have organisational support are usually rejected. Badly built chulhas do not give the benefits that are promised. The history of the improved chulha in India is full of such failures.

Now once again there is a lot of interest in the improved chulha. It is being seen as a solution for many problems—of reducing deforestation, of reducing drudgery in women's lives, of helping women improve their status. Funds from government or non-government agencies are easily available. But how to change good objectives into real achievements is still not understood. The main person not getting enough attention is the woman user. The whole structure for spreading the chulha must be built around her needs and priorities. It is she who will decide its success or failure.

This handbook is one of four publications developed in the hope of filling some of this gap in understanding. The handbook deals only with the Nada Chulha. We hope that it will provide a basis for developing similar material for other improved chulhas of the fixed type.

2. HOW THE HANDBOOK WAS DEVELOPED

The Nada Chulha design system and the method for spreading it have evolved out of a 'learning by doing' approach. This handbook was developed by the same method. To begin with chapters IV and V were put together as a trial edition. They were then tried during five training courses for chulha mistris. Three of the courses were organised jointly with voluntary organisations - the Social Work and Research Centre (S.W.R.C.) Jagjitnagar, H.P.; the Haryana SWRC, Khori; and SWRC, Mada, Rajasthan. During these courses, trainees from many other organisations were also invited. The other two courses were for the state governments of Haryana and Punjab. Each course was one week long. Detailed preparation was done in advance. Trainees were selected carefully according to the work they would have to do. After each course we kept in touch with the trainees' progress through regular reports and visits. Shortcomings of earlier courses were made up during later ones. Some good chulha mistris were invited to later courses as training assistants. This was to help them learn even training skills. This way, the training of mistris and trainers was combined to some extent.

A number of organisational structures for spreading the chulha were also tried out with the trainees' organisations. Their working was observed carefully. Changes were made in them to solve problems as and when these came up.

Trial record keeping cards were given to mistris and supervisors to monitor the impact of the chulhas on users' lives.

All through, we tried to teach according to rural women's traditional ways of learning - ways they are already used to and enjoy. Talking by instructors was kept to the minimum. More importance was given to role play and practical work.

In spite of this we were aware that the

best method of learning is through actual practice in solving real problems. The training course was thus seen only as preparing the ground for the trainees to learn through doing the work. During this phase, follow up and support to trainees was given due importance.

During the training courses, the way illiterate women 'read' drawings was observed carefully. We wanted to learn how to make teaching materials suitable for their needs. Several formal methods of visual communication had to be given up in the process. For example, it became clear that the use of arrows to show direction, of ticks and crosses to show right and wrong, made no sense to our trainees. When asked to explain chulhas through drawing, they drew beautiful plans with chimneys shown on them in elevation.

Most illustrations in the present handbook and the construction manual were again tested on some of our ex-trainees—those now working as mistris, supervisors, or trainers. Many had to be changed a lot to make them useful for our target users.

Our original plan was to test even other chapters by bringing out trial editions. We were not able to do so due to reasons beyond our control. Because of that, five ouf of seven chapters of this handbook should be seen as a trial edition.

An information sheet for chulha users, however, was produced and tried out. 5000 copies of this were used during training courses or distributed among Nada Chulha users. The sheet has been useful in educating trainees, users, and their friends, about how to use and maintain the chulha in the best way. A revised edition has therefore been included in the present set of materials. It is recommended that all those spreading the Nada Chulha should use these in their programmes. Each new chulha owner should be left with a copy pasted in an easily visible location.

One of our collaborating organisations, S.W.R.C., Jagjitnagar, produced a poster on the chulha. It helped people interested in the chulha to know whom to write to for more information or how to ask for help in getting chulhas built. The large number of requests received because of the poster gave a good idea of the demand for the chulha in the region. However, use of a poster is useful only for those organisations who can meet so much demand.

3. WHO THE HANDBOOK IS FOR

Chulha project coordinators and supervisors are our main target users. They can use the handbook for constant reference.

The handbook is also meant for trainers of chulha mistris.

The handbook can also be used by interested individuals or organisations to do their own experiments. **It should not be used as a recipe book or a do-it-yourself manual.** It is mainly meant for persons who have already been trained and are actively involved in training others or in spreading the chulha. We hope that it will encourage field workers to maintain an attitude of changing the technology to help women gain better control over their lives. We feel that people should be helped to control the technology through understanding it better. That will help them develop or change it to meet their special needs.

Our original plan was to develop a separate handbook for trainers of chulha mistris after testing a trial edition.

However, in the mean time, the Department of Non-Conventional Energy Sources (DNES), Government of India, launched a large National Project for the Demonstration of Improved Chulhas (NPDIC) in December, 1983. The NPDIC aims to train one hundred thousand village women as chulha mistris by the end of March 1985. The project has accepted some basic aspects of the method developed for spreading the Nada Chulha. The Nada Chulha is one of the chulhas approved for use under the project.

Unfortunately, however, the methodology and skilled workers necessary for doing

training on such a large scale are not available. State governments, asked to meet big targets, have been searching unsuccessfully for enough trainers to train their chulha mistris. A good government project might fall because implementing agencies do not understand what training of village women involves. The NPDIC also does not mention the organisational structure necessary for execution. There is no provision for preparation before training or for giving follow up support to trainees or users after training.

This handbook was made suitable for trainers of chulha mistris to help train more mistris quickly. The NPDIC made this rather urgent. However, the handbook is still weak in this respect. We hope to bring out another handbook specially for trainers in the coming months.

4. HOW TO USE THE HANDBOOK

The handbook is divided into seven chapters. This is given in the table of contents. Each chapter starts with instructions to trainers of chulha mistris. These are presented within a box. The instructions tell how and when the chapter can be used during a training course. An appendix at the end gives an outline of a training course.

Chapters IV to VII deal with construction, planning, use and maintenance, and common problems faced by users. Each of these chapters has been made quite self-contained for easy reference and use. For example, when a supervisor has to solve a user's problem, she can refer only to chapter VII. When users have to be explained how to use and maintain the chulha properly, reference to chapter VI will be enough. For teaching construction, chapter IV is almost complete. While teaching or making design changes for special needs, chapter V can be used. Making the chapters self-contained has resulted in some repetition. But we thought it was worthwhile for making the handbook more useful.

In many chapters, illustrations show the effect of both correct and wrong use or construction. As ticks and crosses to show right and wrong in the trial edition were found confusing, here we have tried a new method. A woman's smiling face has been placed next to illustrations showing correct use.

An unhappy face next to an illustration means wrong use or construction.

We hope that the handbook and its companion publications will meet a long felt need for teaching and working documents on the improved chulha for field workers. We have tried hard to make the content and format suitable for their needs. But this is just the beginning. We hope that many others will help us to improve it further.

Chapter 1

THE NADA CHULHA, WOMEN AND COOKING

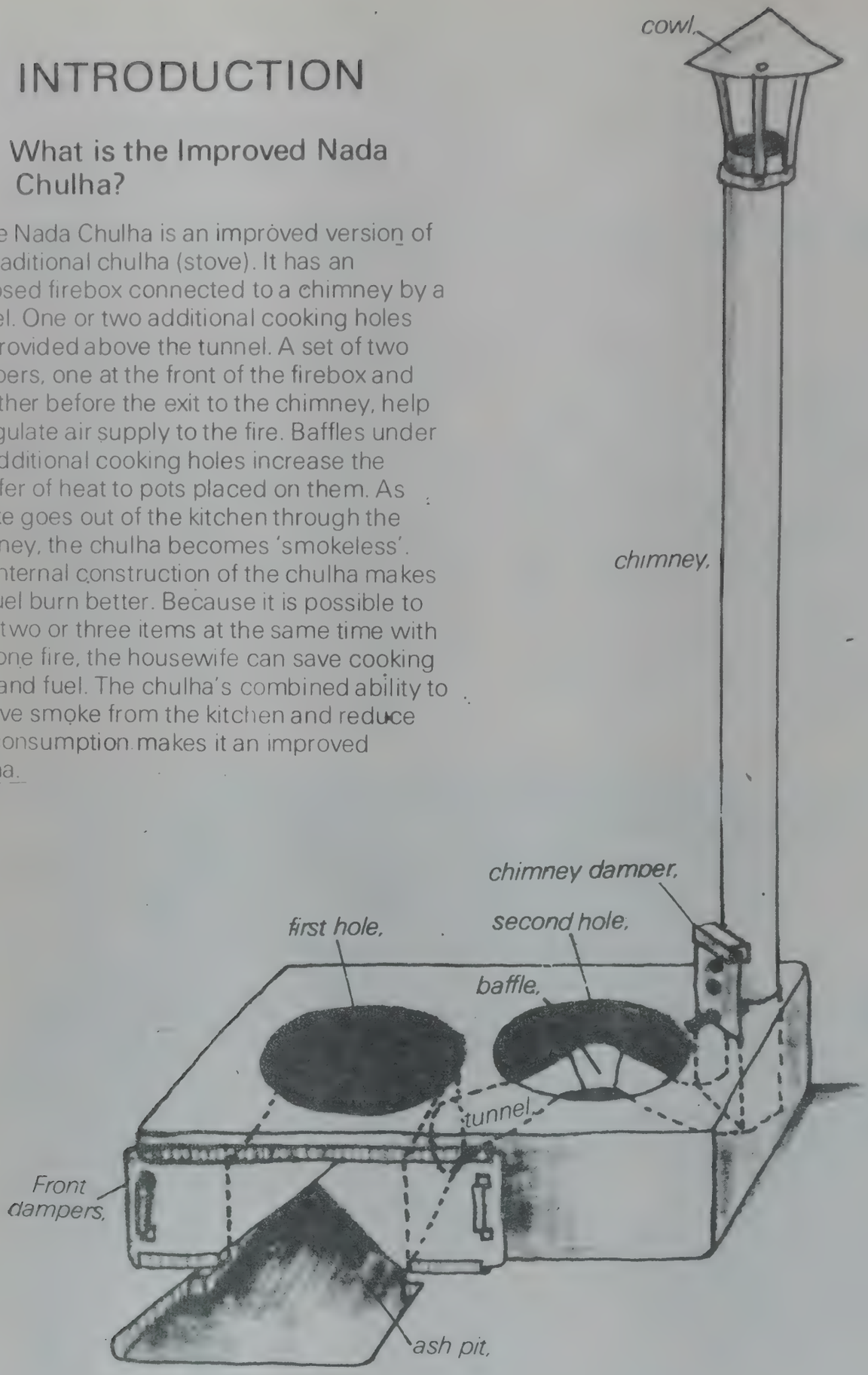
This chapter gives a brief introduction to the Nada Chulha, how it was developed, and how an improved chulha can reduce the daily drudgery in women's lives. During a training course for chulha mistris it can be used for the introductory session. While discussing drudgery related to cooking and fuel, trainees should be encouraged to talk about the main problems of women in their villages. In some areas these could be due to smoke. In others due to shortage and type of cooking fuel. In still others, these could be the time and effort spent on cooking. The Nada Chulha can make an impact on all of them.

Trainers should also emphasise how the Nada Chulha has developed with the full participation of women users. This has resulted in a flexible design system which can be adapted to different needs. After training, the trainees should be encouraged to remain sensitive to users problems through constant interaction with them. This is an important part of the Nada Chulha method of spreading the technology.

INTRODUCTION

1.1. What is the Improved Nada Chulha?

The Nada Chulha is an improved version of the traditional chulha (stove). It has an enclosed firebox connected to a chimney by a tunnel. One or two additional cooking holes are provided above the tunnel. A set of two dampers, one at the front of the firebox and the other before the exit to the chimney, help to regulate air supply to the fire. Baffles under the additional cooking holes increase the transfer of heat to pots placed on them. As smoke goes out of the kitchen through the chimney, the chulha becomes 'smokeless'. The internal construction of the chulha makes the fuel burn better. Because it is possible to cook two or three items at the same time with only one fire, the housewife can save cooking time and fuel. The chulha's combined ability to remove smoke from the kitchen and reduce fuel consumption makes it an improved chulha.



A 2-holed Nada Chulha and its parts

Sheila cooking on her old chulha in a blackened kitchen.

A will to change.....
Sheila fixing a chimney to her old chulha.

The changed kitchen – clean, healthy and bright.

1.2. How the chulha was developed

The Nada Chulha shares its design principles with several other 'smokeless' chulhas in India and abroad. However, it has evolved through a special development process based in innumerable village homes. This started in the small kitchen of Sheela, a poor landless woman of Harijan Nada in October 1980. Nada is a village near the Shiwalik hills in Haryana. Sheela was found making her own efforts to remove smoke from her kitchen and reduce her fuelwood consumption. This led to the first experimental 'smokeless chulha' being built in Sheela's kitchen. The design, construction method and way of spreading the present Nada Chulha has evolved since then through further trial and experimentation. The women of Nada have participated in every stage of this process. By using the chulha and making changes to it they have helped make a theoretically useful technology into one which is practically useful to a large percentage of rural Indian women. The chulha has been named 'Nada Chulha' because of the special contribution of Nada women to its development.

2. WHY AN IMPROVED CHULHA?

2.1. The chulha and daily drudgery in women's lives

Work related to cooking and the chulha normally takes many hours of a woman's daily life. Although modern technology has revolutionised agriculture in some states, there has been little improvement in the traditional chulha. This is particularly so in the 'green revolution' states of Punjab, Haryana, and Western U.P.. There, the food of most families is still cooked on simple U-shaped mud chulhas. It is likely that if men had been responsible for cooking, the chulha would have been improved long ago. It is because cooking is traditionally women's responsibility, and because they have little access to modern science, that they have had to silently suffer the inconveniences of traditional chulhas for generations.

The Nada Chulha was born out of a poor woman's desire to remove smoke from her kitchen. Her son wanted her to reduce fuelwood consumption because it meant back breaking labour for him to collect it from denuded hills. Smoke removal from the health point of view and saving fuelwood for ecological reasons are the two more known benefits of improved chulhas. For rural women, however, improved chulhas have much more to offer.

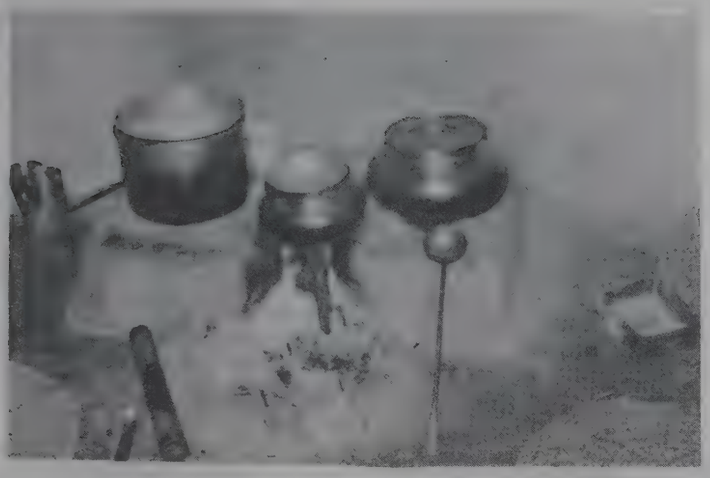
a) Smoke

Let us first look at the effect of smoke. The health hazards and discomfort caused by smoke are obvious. According to studies done at the East West Centre in Hawaii, the amount of cancer causing particles breathed in by women from smoky fires in closed kitchens can be equal to smoking twenty packets of cigarettes per day. Hill women breathe in more smoke in closed kitchens due to the cold. In the plains, where dung cakes are the main fuel, the fire smoke causes more irritation and is more dangerous. Most women know that smoke is dangerous. They believe it causes early blindness and breathing troubles. Further, as a smoky kitchen is unpleasant to be in, the woman cook tends to spend long hours by herself. A smokeless kitchen can increase interaction among family members as men and children are likely to spend more time there.

b) Time and labour spent on cleaning

Walls blackened by smoke require frequent mud washes. Much time and labour is spent on this. Many women in Himachal have said that earlier they had to give mud washes to kitchen walls every second or third day. With the Nada chulha they need to do so only once

Somti, a proud and happy chulha mistri of Nada, with the new chulha she has built.



Blackened pots on a traditional chulha.

The misery of scrubbing pots

Sparkling pots on a Nada Chulha on which three things can be cooked at the same time.

in two or three months. This in itself is a major attraction of the new chulha to them.

Where walls are whitewashed, repainting costs not only time and labour but also money. Further, smoke from chulhas enters living rooms depositing soot on clothes and other household goods. This again demands a lot of time and effort to keep the house clean.

c) Scrubbing blackened utensils

Cooking on traditional chulhas makes utensils get blackened all over. These need to be scrubbed everyday. This is a painful and time consuming chore. Scrubbing utensils of a large family can take 1 to 2 hours of a woman's daily time. Many women put forward the roughened palms of their hands to show what scrubbing pots has done to them.

Utensils get blackened only from below with the improved Nada Chulha. Women users are overjoyed at being relieved of this painful daily chore. In addition, the utensils last longer. The time and water required for washing them is also reduced. Where water has to be brought from long distances, the lesser water required also saves hard labour and time.

d) Cooking time

The U-shaped mud chulha is the most common traditional chulha in the north Indian plains. Only one thing can be cooked on it at a time. If the normal family meal consists of two or three cooked items, these have to be cooked one after the other. The woman has to spend a lot of time on cooking and being exposed to smoke and heat. For faster cooking, two chulhas have to be used. This increases fuel consumption and the woman has to manage two fires instead of one. Up in the hills, even traditional chulhas have two, three and sometimes four cooking holes. This is due to the greater need for hot water and keeping food warm. Although this is an improvement over the U-shaped chulha, the heat in the additional cooking holes is often not enough for cooking.

With the improved Nada Chulha, two or three things can be cooked at the same time. In winters, while something is cooking on the first hole, water for bathing or washing can be heated on the second. This can also increase

the number of times family members bathe in winters. But, for the woman, the greatest advantage is the saving in her cooking time. Housewives of larger families say that with the Nada chulha they spend two to three hours less than before on daily cooking.

e) Women's status

Thus, as far as women's daily drudgery related to cooking is concerned, the improved chulha can make a lot of impact. It can reduce the time and effort spent on cooking. More time can become available for better child care, productive work and rest. Improved health and sanitation can improve well being of the whole family. As young girls often do the cooking, it can mean a healthier new generation of women. Most of all, as the technology mainly benefits women, the improved chulha can help overworked and exploited rural women get a new consciousness. It can make them want to improve their lives and status in society.

2.2. The Chulha and the cooking fuel crisis.

In recent years, there has been a lot of concern over our natural environment getting damaged. Many people think that the 100 million traditional chulhas used in Indian villages are responsible for the fast destruction of our forests. This relationship is not always true. In many parts of north India, dung cakes, agricultural residues and weeds are the main cooking fuel. Where firewood is used, mainly twigs and branches of trees are burnt. Villagers seldom cut whole trees for their own use. The destruction of forests seems more a result of too much grazing, changing of forests into agricultural land, industrial and commercial demand for wood, and the export of fuelwood from rural to urban areas. But there are parts of the country where rural fuelwood consumption could be increasing deforestation.

Krishna of Nada saves a lot of cooking time wit her new chulha. Here she is making rope with a new air of self-confidence.

It is a fact, however, that more and more rural households are finding it more difficult to get cooking fuel. This is because of the destruction of trees and forests and commercialisation of even fuels like dung cakes. The responsibility for collecting and processing cooking fuel is mainly that of women and children. The time and labour they have to put into the task is increasing day by day. Hill women of U.P., Himachal and Meghalaya now have to walk many kilometers spending several hours on each trip, to bring back a headload of fuelwood. In the plains, the use of dung cakes and weeds is increasing due to shortage of fuelwood. Making cakes from animal dung takes a lot of women's daily time and labour. Besides, this deprives the soil of a valuable organic fertilizer and soil

conditioner. Where thorny weeds are the only fuel available, cutting these is unpleasant and painful. Where children do this work, their health and education suffer.

Thus, an improved chulha which also helps reduce fuel consumption can help rural families to cope better with the cooking fuel crisis. For the women and children responsible for fuel collection and processing, it can help reduce the time and effort required for the purpose.

3. THE NADA CHULHA SYSTEM.

3.1. The design system

The Nada Chulha is a **flexible design system** responsive to widely varying individual and regional needs. It has no standard shape or size other than the internal height of the firebox. The sizes of cooking holes and distances between them are based on sizes of commonly used utensils. The number of cooking holes and how they are placed is decided after consulting the women users. The chulha can be rectangular, square, semi-circular, T or L shaped. This depends on what users like aesthetically or the space available in the kitchen. Only skilled chulha mistris with a good understanding of the principles on which the chulha works can build good chulhas. The design principles are outlined in chapters IV and V.

Mud slabs (chaapris) being made with simple moulds.

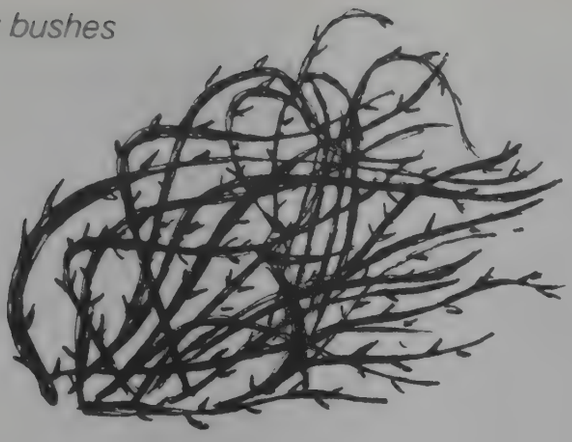
3.2. The construction method

The Nada Chulha construction method is based on the traditional chulha building method in the Nada area. Once learnt, it helps mistris build different types of chulhas with minimum labour and time. The quantities of *gara* (clay and straw mix) required are much less than those for other construction methods. The chulha dries quickly. Therefore, the time for which the kitchen cannot be used is reduced.

The method consists of making mud slabs (called *chaapris* locally) which are ¾" (18mm) thick, 7" (175 mm) wide and of variable length. These are dried in the sun Simple and cheap moulds are used to make them the same size. The chaapris are used to build a skeleton structure of the internal tunnel and outer form of the chulha. These are held together and to the ground with gara. (See chapter IV). If chaapris and gara are kept ready, and there is no problem in fitting the chimney, an experienced chulha mistri can build a 2-holed chulha in 30 to 45 minutes and a 3-holed one in about an hour

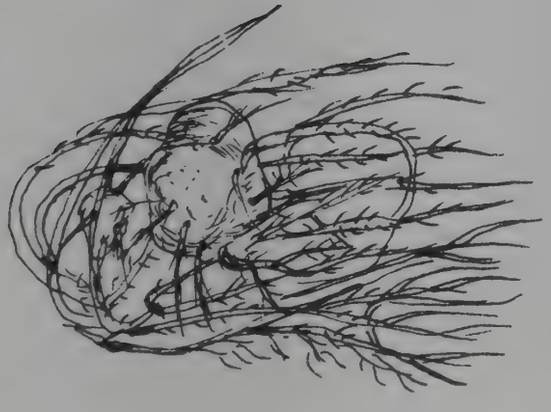
Chaapris used to make the structure for a 3-holed chulha

thorny bushes



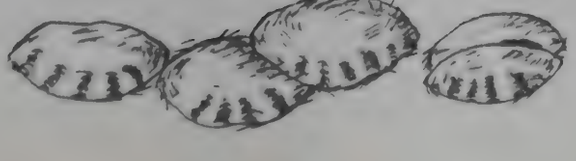
corn cobs

roots and weeds



fuelwood

dung cakes



4. WHEN AND WHERE THE NADA CHULHA CAN BE USED.

4.1. Cooking fuels.

The Nada Chulha is mainly designed for burning biomass fuels. These include fuelwood (from trunks, branches and twigs), dung cakes, agricultural residues, bushes, weeds and pine needles. In areas where the chulha has been introduced so far, all these fuels are used. Small variations in firebox sizes may be required to accommodate their different shapes, sizes and volumes. Trained chulha mistris are able to make these changes.

4.2. Cooking practices.

The Nada Chulha can be used in both rice and wheat eating areas. Rotis (unleavened bread) can be cooked and roasted directly on the fire as on traditional chulhas.

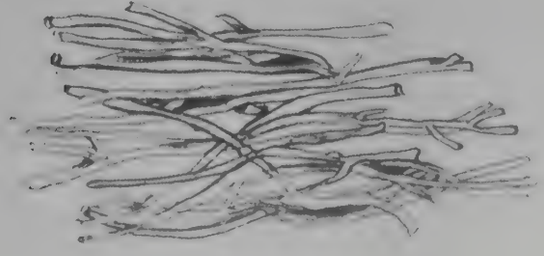
4.3. Family circumstances

The Nada Chulha is suitable only for families with a stable place of residence as it is not portable. The user families should normally have a need to cook or heat at least two items at the same time. These need not be a part of each meal. The second item could be water, milk, cattle feed or something else.

4.4. Women's status and priorities

The chulha is likely to be more accepted in areas where women themselves want to improve their status and daily lives. It will prove popular among women wanting to remove smoke from their kitchens and to reduce their fuel consumption and cooking time.

agricultural residues



4.5. Regions where the Nada Chulha has been used.

So far, the Nada Chulha has been introduced in the Chopal, Solan and Mandi districts of Himachal Pradesh; Ambala, Hissar, Kurukshetra and Mahendergarh districts of Haryana; Ropar and Patiala districts of Punjab; Dehra Dun, Tehri Garhwal, Nainital and several other districts of Uttar Pradesh; Panchmahals and Vadodra districts of Gujrat; and Dungarpur and Banswara districts of Rajasthan. In all these areas the chulha has become accepted and popular. In most cases, small changes had to be made to accommodate local needs and priorities.

In a country as large and diverse as India, it is better that before the chulha is intorudced in a new area, it should first be tried on a small scale.

4.6. Domestic use

Till now, the Nada Chulha has been introduced only for domestic use. Adapting it for commercial establishments and institutions has been tried on a very limited scale. Further testing in such settings is necessary.

5. WHERE THE NADA CHULHA SHOULD NOT BE USED

5.1. Cooking fuel

The Nada Chulha is unsuitable for families or areas where the main cooking fuel is coal, coke or balls made out of a mixture of coal powder, mud and cow dung. The burning properties of these fuels are different from those of biomass. The chulha will require major design changes to make it suitable for them.

5.2. Family circumstances

It is by and large unsuitable for homeless or squatter urban families who are likely to move frequently. This includes construction labour moving from one construction site to another. Even lower middle class urban families living in rented houses are unlikely to find it suitable. Their landlords might object to a hole being made in the roof for the chimney.

The states in which the Nada Chulha has become popular.

5.3. Poverty and backwardness

The chulha is also unsuitable for extremely poor families who can only afford a one item meal which takes only 15 to 20 minutes to cook. They will not get the benefits of fuel conservation and savings in cooking time. Similarly, in very remote and backward areas where people still suffer from oppression and exploitation, an improved chulha might not be a priority until people's overall lives have improved.

5.4. Special regional needs

Finally, there are some regions in the country such as Meghalaya in the north-east, where chulha smoke is considered useful for many purposes. These include preservation of grain, thatch, timber and other goods during the long rainy season. Meat and fish are preserved by smoking them above the chulha. People in Meghalaya also have the healthy tradition of drying fresh fuelwood by storing it above the chulha. In such areas, the Nada Chulha will require many changes to be made suitable.

Chapter 2

HOW TO RUN A CHULHA PROGRAMME

This chapter is designed for all those concerned with spreading improved chulhas or training chulha mistris. It is divided into two sections. The first looks at the history of the improved chulha in India. It also examines why the chulha was not accepted on a large scale in the past. Although this need not be used much in a training course for mistris, it should be read by project co-ordinators, supervisors and trainers to avoid repeating past mistakes.

The second section deals with the main elements of a successful method for spreading the chulha. This includes an outline organizational structure which could be used for the purpose. Selection of mistri trainees should be done according to the criteria outlined. This will avoid wastage of resources on training unsuitable candidates. During a training course, the terms and conditions on which chulha mistris will be working after the training and their responsibilities should be discussed with them clearly. Project directors of the organisations who send the trainees should participate in this session. This should be held towards the end of a course.

1 THE NEED FOR A PROGRAMME.

The Nada Chulha has to be built where it is to be used. It is therefore necessary to have a network of skilled chulha mistris. Mistris need to be selected with care. They have to be trained and provided with organisational support to function effectively. A voluntary or government organisation has to perform these tasks within a clearly defined programme. If there is no such programme, the technology will not spread in a lasting way. It is also likely to be rejected by its users. This has already happened to the improved chulha in the past.

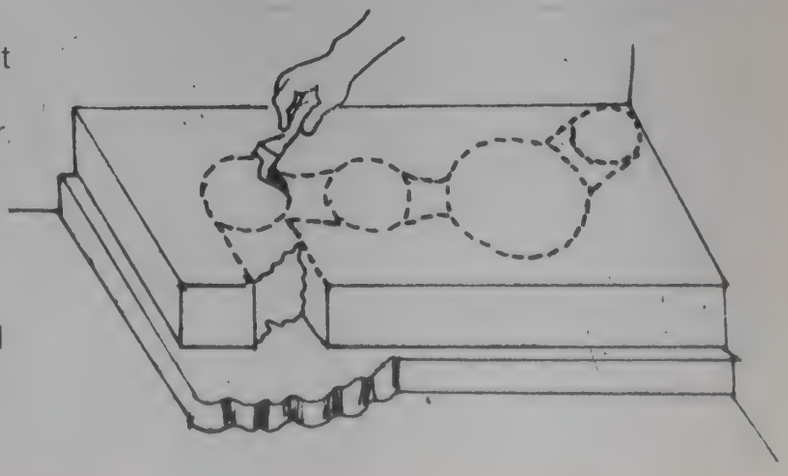
SECTION I

2. HISTORY OF THE IMPROVED CHULHA IN INDIA

2.1. The 'HERL' Chulha

India has been a pioneer in the development of improved chulhas. Work on the 'HERL' or 'Hyderabad' chulha was started in 1946 by Dr. S.P. Raju, Director of Hyderabad Engineering Research Laboratories. This was one of the first 'smokeless chulhas' and provided the basis for many variations available today.

The 'HERL chulha' consisted of an enclosed firebox with a front opening for putting in fuel. The firebox was connected by a horizontal tunnel to a chimney. Two or three cooking holes could be provided above the tunnel with



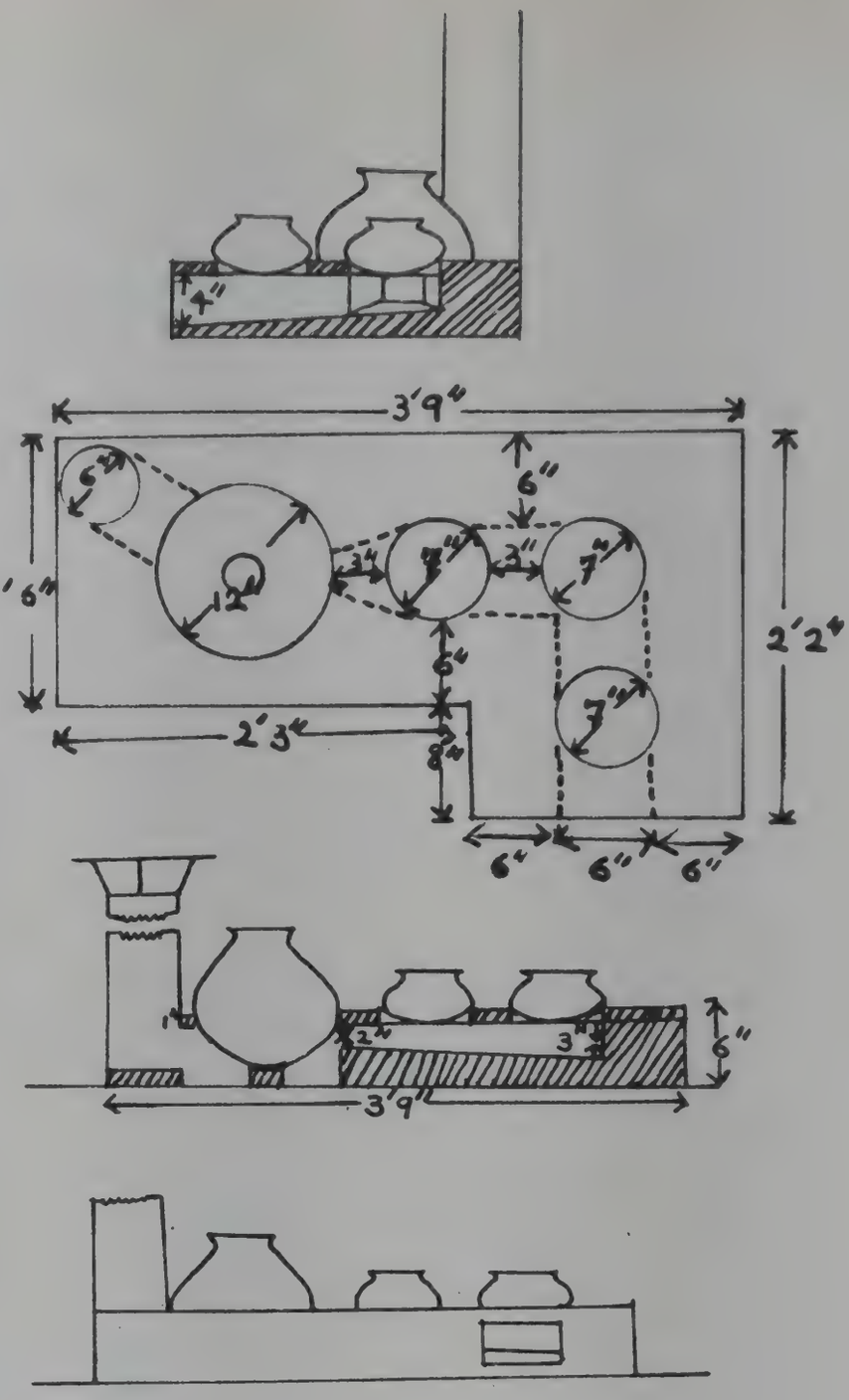
the last hole being used only for heating water. A damper was provided for regulating draft. The chulha could be made linear or L-shaped with size and number of cooking holes adapted to individual requirements. The basic materials were mud and a fired clay chimney. Instead of baffles under cooking holes, Dr. Raju's design had a narrow sloping tunnel. The distance between the pan bottom and tunnel floor was only 2 inches (50 mm).

The construction method consisted of making a 5 inch (125 mm) high solid mud block and carving out the internal structure in it. The tunnel was roofed with an additional layer of mud. Dr. Raju developed many variations of the basic design for different types of users - rich and poor families, institutions and village industries. Construction details and instructions on how to use the chulha were distributed through a booklet called 'Smokeless Kitchens for the Millions'. This was first published in English in 1953 and revised editions and reprints brought out in 1954, 1955, 1959, 1961, 1966 and 1981. This shows the tremendous and continuing interest in the HERL chulha. The booklet was also published in Telugu and Marathi.

Dr. Raju mainly wanted to improve the health and housing conditions of the people. However, he was also aware that his chulha could help save forests and improve the household economy. He felt that the chulha could reduce fuelwood consumption by 25 percent.

2.2. The Magan Chulha

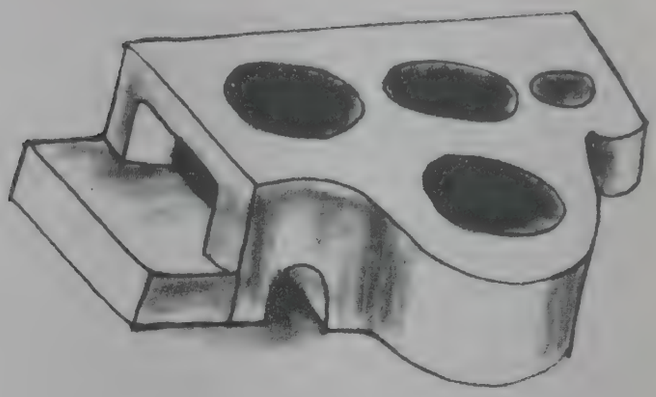
The HERL chulha provided the basis for the equally famous 'Magan Chulha'. This was developed by the All India Village Industries Association under the directorship of Dr. J.C. Kumarappa. The association was founded by Mahatma Gandhi in 1933 at Maganwadi, Wardha, for "village reorganisation and reconstruction, including the revival, encouragement and improvement of village industries". Two potters from Maganwadi were sent to Hyderabad to learn the technology. On their return to Wardha, they simplified the construction method of the HERL chulha and improved the design further. They introduced baffles under cooking holes, a



Hyderabad Smokeless Chulha with three holes and hot water pot.

grate in the firebox and a damper between the firebox and second cooking hole. This was for regulating chimney draft. The new chulha was named Magan Chulha. The method of making baked clay pipes was learnt from Kerala. This was to produce a cheaper chimney and to create more employment for village potters.

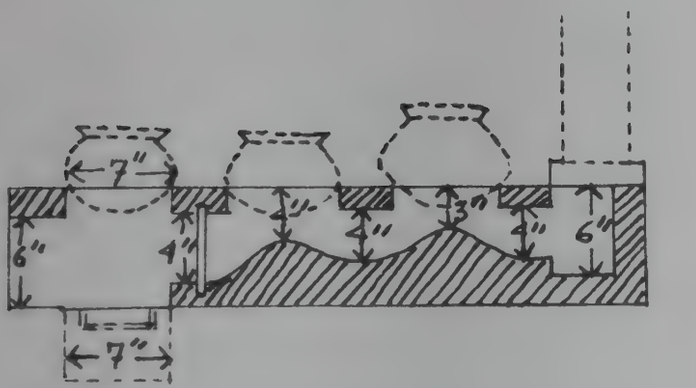
The Magan Chulha construction method consisted of preparing a wet mixture of 10 parts clay, one part chopped straw (by volume) and some cow or horse dung. After

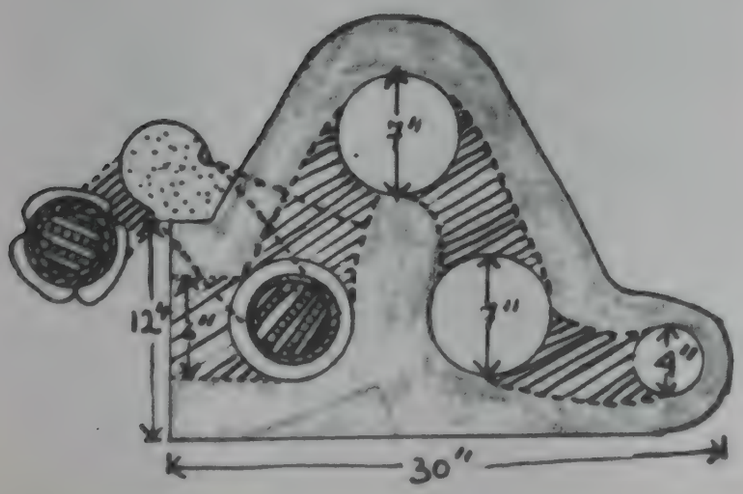


allowing the mix, which had to be sprinkled with water every second day, to mature for a week, a compact block measuring 30" × 27" × 10" (750 × 675 × 250 mm) was made. When this had hardened enough, the firebox, two additional cooking holes and a tunnel linking the three to the chimney, were carved out. According to the instructions, the centre points of the three pot seats should form the corners of a triangle with equal sides The recommended diameter of the chimney was 4" (100 mm). Pot seats could be shaped by rotating a pot with a round bottom in the cooking holes. This helped a good fit between pots and holes. The use of cast-iron rings of different diameters was recommended for using different pot sizes on the cooking holes.

Spreading the Magan Chulha was taken up by a band of devoted workers. Models of different sized chulhas were kept at Maganwadi. Burnt clay pipes, cast iron rings and dampers were put up for sale. A booklet called 'Magan Choola' was first published in 1948 and a revised edition in 1953. This gave details of how the chulha was to be built and used. Around 1948-50, 120 Magan chulhas were built in lower middle class houses in Wardha town. Repair and maintenance of the chulhas was done by Maganwadi workers.

Besides, a large number of students coming to Maganwadi from Gandhian institutions all over the country were trained to build the chulha. On returning to their organisations they spread the technology in their own areas.





plan and section of the Magan Chulha.

2.3. The Portable Magan Chulha.

This resulted in development of the 'Portable Magan Chulha' at Gandhi Niketan Ashram at Kallupatti near Madurai in the early

1950's. The portable chulha consists of burnt clay parts made by potters. These can be bought from the Ashram or from a number of shops. The owner can put together the chulha in her kitchen with *gara.* The Gandhi Niketan Ashram also published a booklet to spread information about the portable chulha. The first edition of 1000 copies of their 'Magan Choola' was produced in 1955 This was followed by a second edition of 2000 in 1957. To start with, even the portable Magan chulha had three cooking holes. At present the Ashram makes 2-holed chulhas.

2.4. The Community Development Programme.

Another big effort to spread the smokeless chulha was made through the Government of India's 'Community Development Programme' in the 1950's. Field level government workers were given time bound targets for their areas. In numbers, perhaps hundreds of thousands of smokeless chulhas were built in village homes under the programme.

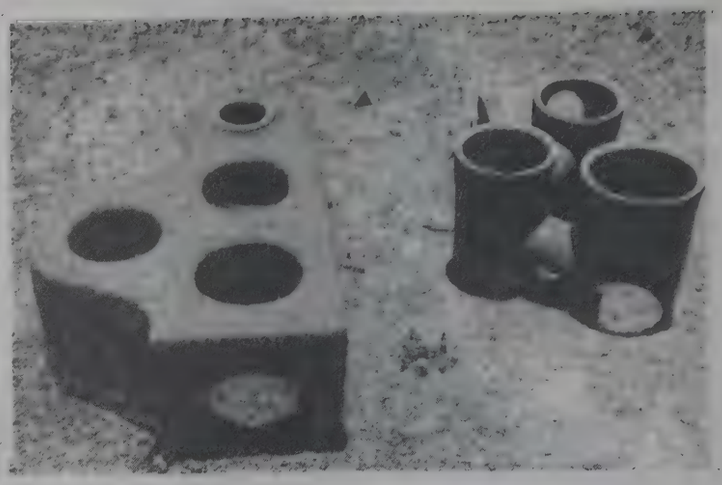
After these early efforts, a large number of other government and non-government organisations have developed variations of the 'smokeless' chulha and tried to spread them. It is not possible to look at or even list all of them here. The important question is why, even with so many and often devoted efforts, did the improved chulha by and large not get accepted on a large scale?

3. REASONS FOR PAST FAILURES

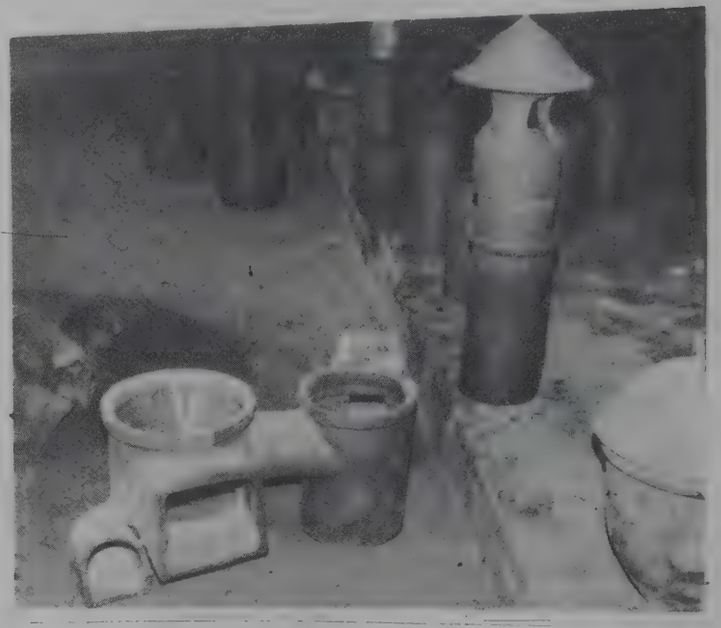
Although available information is limited, the following seem to have been the main reasons for the improved chulha not becoming popular:

3.1. Unclear method for spreading the chulha

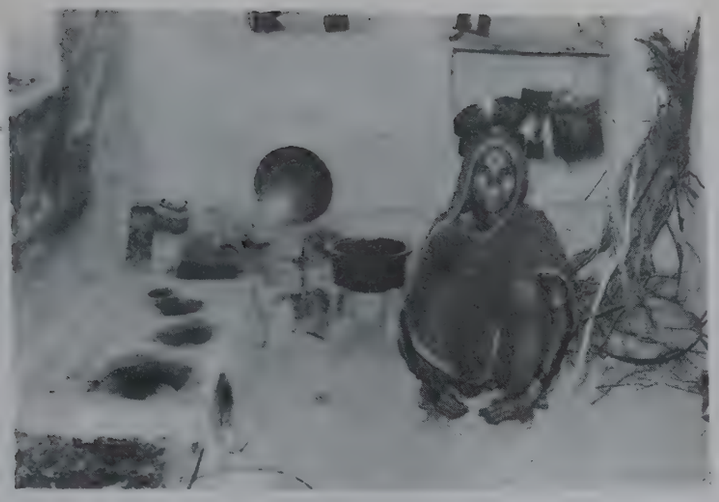
A clear methodology for spreading the chulha was either not worked out or did not include important aspects. Such a methodology should have three parts of a) letting users know about the benefits of the chulha, b) making sure that they get chulhas which work properly, and c) that users are helped to understand and use the chulha properly.



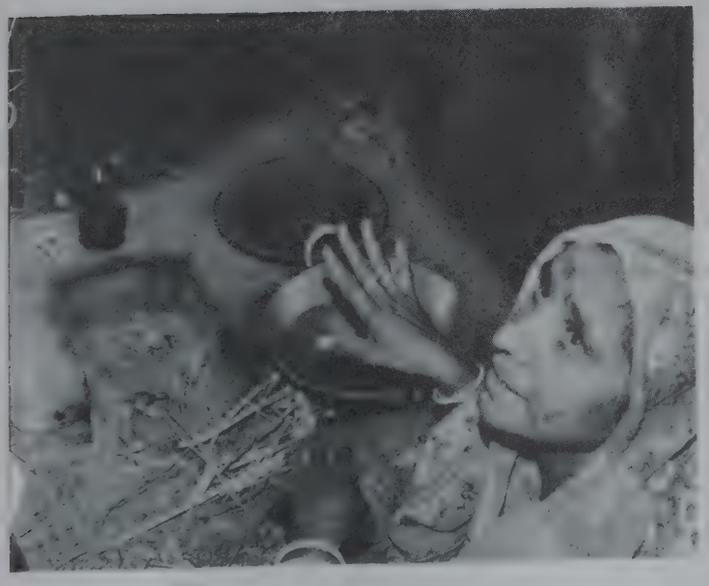
The parts of a 3-holed 'portable Magan Chulha.



The 2-holed portable Magan Chulha developed by Gandhi Niketan Ashram, Kallupatti.



A 3-holed Magan Chulha without a chimney built in the house of a poor woman. She still does most of her cooking on her old chulha.



A badly built 'smokeless' chulha in Gujrat which does not remove smoke. The woman has attached a traditional chulha to the new one as she is clearly not happy with it.

3.2. Top down approach

A top down approach was used. In this, men with no experience of cooking and related problems tried to make women accept the chulha considered 'good for them'. With women given a passive role, their participation in making the chulha work did not become available. If women stopped using their chulhas, it was thought that it was because of their backwardness or not being educated. Little effort was put into making sure that the chulhas really worked properly.

3.3. Spreading done by outsiders.

Spreading the technology was mainly done by outsiders. Little importance was given to training local women to build, repair and maintain the chulhas. When the outsiders stopped coming, even working chulhas were slowly given up. This happened in the case of Maganwadi at Wardha.

3.4. Spreading through construction manuals.

Or else, attempts were made to spread the chulha with the help of construction manuals. This was done for the HERL and to some extent the Magan Chulha. This approach assumes that the technology is so simple that by following written instructions every household can build its own chulha. This has clear limitations in a country where the majority of grown ups cannot read, especially the women users. Another problem with this approach is that one does not know whether the reader has understood all the instructions or been able to get all the promised advantages.

3.5. Spreading done by badly trained workers.

It was not recognised that building improved chulhas requires skill obtained through good training and practical experience. The designers of the HERL and Magan chulhas spent a few years in developing the chulhas themselves. However, they assumed that village women could learn the skill through watching a demonstration of the construction method. Often, even the demonstrators were not properly trained.

Construction which was not correct resulted in smoke not going out, fuel consumption increasing or slow cooking of meals - the opposite of what was promised. The soot could not be removed from many chulhas when the chimney got blocked. These were broken by their unsatisfied owners.

Construction manuals gave fixed dimensions for the chulha and the cooking holes. The badly trained workers could not change the basic design according to individual or regional needs. Big 3-holed chulhas, which took a long time to heat up were built in houses of poor families who could barely afford a one item meal. Their taking too much space in the kitchen made the chulhas even more unpopular.

3.6. Regular supply of materials not assured.

Usually, no structure was created for the regular supply of rings, chimneys or dampers Many 'smokeless' chulhas were built without chimneys as chimney pipes were not available. On many others, cooking holes were too big or too small for normally used pots. But no rings were available to make it possible to use different sized pots.

3.7. No education of users

Seemingly, little effort was put into educating users about the principles on which the chulha works and how to use it in the best way. This combined with little or no follow up of how the chulhas were working or the problems faced by users, led to problems not being solved at the right time. As the success of a technology depends on users being able to take full advantage of it, this was another big reason for past failures

SECTION II

4. ELEMENTS OF A SUCCESSFUL METHOD FOR SPREADING THE CHULHA.

The Nada Chulha experience and reasons for failures in the past suggest the following elements for a successful method for spreading the chulha.

4.1. Construction by skilled chulha mistris.

It must be recognised that building improved chulhas requires skill, sensitivity and understanding of the basic principles involved. It is easy for most persons to put together something that looks like an improved chulha. However, they do not understand how its different parts relate to each other and how this affects the working of the chulha. Badly built chulhas do not work properly. Spreading the improved chulha should therefore be done only through skilled chulha mistris.

4.2. Who can be chulha mistris?

Local village women, who also use improved chulhas, make the best chulha mistris. Being local, their accountability to users is high. They are available for helping them solve problems when they come up. They can take care of repair, maintenance, reconstruction or new construction. Being women responsible for cooking in their own homes, they have a first hand experience of local priorities and problems related to cooking. Their communication with, and access to, other women is easier and better compared to that of men.

Trainees learning to make gara during a training course held at HSWRC, Khori

Trainees practising chulha layout at SWRC, Mada, Rajasthan.

Trainees practising shaping of cooking holes at SWRC, Jagjitnagar.

4.3. Selection and employment of chulha mistris

A spread out network of women chulha mistris can provide the foundations for long term technology transfer to the community. However, the women must be selected with care.

—They must have time to do the work.
—They must be acceptable to all members of the community.
—They must be able to move around and travel to other villages.
—They must be quick-witted.
—They must be good at working with their hands, especially with mud.
—Their family and social circumstances must not be an obstacle to their working as mistris.
—They must have first hand experience of cooking on traditional chulhas with local fuels.
—They must be willing to adopt the improved chulha before starting work as a mistri.

They must be given definite responsibilities.

They should have a clear idea of the terms on which they will receive payment. Chulha mistris may be salaried employees or self-employed like other village artisans. However, self-employed chulha mistris will need organisational and financial support for at least six months to get established. They could be given a monthly stipend or paid on a per chulha basis.

4.4. Training of chulha mistris

Thorough training is required to develop skilled chulha mistris. Simple demonstration of the construction method is **not** enough for the purpose. The formal training of mistris should be at least 7 and preferably 10 days long. Training should include teaching of

—construction method
—sensitization to users' different needs
—making suitable design changes
—proper location of chulhas in different kitchens
—cooking on improved chulhas
—repair and maintenance of chulhas
—how to identify and solve common

problems, and,
—how to help users learn to use the chulha properly.

The training should be conducted in a village to help trainees learn to handle real life problems. Formal training should be followed by a period of supervised practice till each trainee has mastered the skill fully. An outline structure of a training course for chulha mistris is given in Appendix I.

4.5. The organisational structure required

The selection, training and establishment of women chulha mistris requires a three tier organisational structure. This should consist of a 'project co-ordinator', one or more 'supervisors' and a number of chulha mistris. Responsibilities at all three levels must be clearly defined.

a) Project Coordinator

For larger projects, at least one co-ordinator will be required per block. *For smaller development projects covering a few villages, the project director can also act as the chulha project coordinator but must have a definite time commitment for chulha work. The coordinator has to be responsible for:

—evolving an organisational structure for spreading the chulha including giving tasks to supervisors, working out time schedules, the basis on which chulha mistris are to be engaged and paid, how subsidies (if any) should be given and charges collected from beneficiaries.

—organising and accounting for chulha funds

—appointing and helping supervisors solve problems.

—organising training for supervisors and chulha mistris.

—arranging the purchase/fabrication and delivery of chimneys, dampers, cowls, rings and tools.

—regular monitoring and evaluation of progress and making mid-project changes when necessary.

Project coordinators should preferably be women sensitive to women's issues with an education equivalent to a graduate. They must be willing to work in rural areas.

b) Chulha Supervisor.

The chulha supervisor should be a full time employee of the organisation with wider responsibilities concerning women's issues e.g. organising mahila mandals (women's associations), women's employment, health and child care. The number of supervisors will depend on the scale of each project. Norms for this can be evolved with experience. As a

A trainee explaining how to use and maintain the chulha to other trainees with the help of the information sheet for users.

*A block is an Indian administrative unit of about 100 villages and a population of about 100,000.

rough guide, there should be one supervisor for 8 to 10 chulha mistris.

The responsibilities of supervisors should include:

—selection of village women for training and employment as chulha mistris and allocating tasks to them.

—visits to project villages to collect information on cooking practices and fuels used. This will help to adapt the chulha for local needs.

—organising the construction and maintenance of chulhas with the help of chulha mistris, preparing lists of users and time schedules for construction, follow up and users education.

—making arrangements for training in the project area including selection of families in whose houses trainees are to build chulhas, advance preparation of gara and chaapris by them and delivery of chimneys and dampers to the houses.

—continuous supervision and on-the-job training of chulha mistris after completion of their formal training and making sure that already built chulhas are working properly.

—collecting charges from beneficiaries, prompt payment to chulha mistris, maintaining records, collecting feedback from users, educating users to use chulhas properly, providing on-the-job training to new trainees, etc.

Supervisors should preferably be women with an education upto matric with some technical aptitude or training. They should first work as chulha mistris to gain field experience of building and maintaining chulhas. They should be good at and willing to work with their own hands. They should be sensitive to women's issues, acceptable to all socio-economic groups, have access to people's kitchens, have an ability to keep records and have personal circumstances permitting them time and mobility for the work.

c) Chulha Mistri

The preferred aptitudes and selection criteria for chulha mistris have already been given in 4.2 and 4.3 above. The responsibilities of chulha mistris include:

—getting gara and chaapris prepared by chulha owners, building chulhas, follow up of users from time to time and teaching users how to use and maintain their culhas chulhas properly.

—keeping the supervisor informed about future demand to ensure timely supply of materials and providing feedback on common problems faced by users.

—assisting supervisors in training new chulha mistris.

4.6. Training and trainers.

Finally, due importance must be given to creating an effective structure for training all three levels of personnel. Training requires special aptitude and skills. All chulha mistris or even supervisors do not necessarily have these. Trainers must have better communication and organisational skills. Training illiterate or barely literate village women demands special techniques as they are unable to learn through formal teaching methods. Greater emphasis must be placed on supervised practical work and learning through role play. Theoretical principles need to be taught through practical demonstrations. All trainers should preferably haye at least 10 years schooling and should be given special training in training skills. It is beyond the scope of this handbook to deal with training of instructors.

Chapter 3

HOW FUEL BURNS AND HOW THE CHULHA WORKS

This chapter is divided into 3 sections. The first tells how biomass burns and how heat moves. The second looks at how the open fire and some traditional chulhas work. The third explains the different parts of the Nada Chulha and how they work.

Trainees at Khori seeing how flames move through heat resistant glass dishes.

The chapter is meant for trainers and supervisors who must understand the principles on which the chulha works. It can also be used for working out practical experiments which can show how the chulha's different parts work. Rural women trainees cook daily on traditional chulhas with biomass fuels. They know how these fuels burn. What they do not understand is **why** some things happen the way they do. Or, how adding a chimney changes the working of a chulha. They need to be taught that a lot of the heat of the fuel lies in gases that can burn. Or, that too much smoke shows that these gases are not burning properly.

We tried the following visual experiments during our training courses. They were very useful in teaching mistris about chimney draft and its effect on other parts of the Nada Chulha. First a fire is lit in a traditional U-shaped chulha. The trainees are asked to see the shape of the flames and how they move around the pot placed above. The humps of the chulha are then removed. Trainees can see that this makes the flames and smoke come out of the chulha mouth. The fire gets air through the front opening of the chulha as before. It can also be seen that when there is no gap between the pot and the top of the chulha, only a small area of the pan bottom gets heat from flames.

After this, a removable piece is taken away from the back of the chulha to connect a short chimney to it. The

horizontal pull of the chimney draft on the flames can be seen at once. Then, the chulha is made higher by putting chaapri pieces on top of its walls. Trainees can see that the flames are pulled away by the chimney without touching the pot. With this they learn how important it is that the inside height of the firebox of a chulha with a chimney should not be too much. In the same way, how draft becomes more with a longer or wider chimney can be shown. Chimneys of different lengths and diameters can be connected to the chulha for this.

The use of the baffle can be shown by adding and taking out the baffle from a 2-holed chulha. How the flames move can be seen by placing special glass dishes on both holes. Trainees can see how the baffle forces the flames to touch the pot before going to the chimney. The importance of the height and shape of the baffle can also be shown by this. How the front and chimney dampers work can also be shown with the help of the glass dishes.

No special equipment is needed for these experiments other than the heat resistant glass dishes. These can be bought from a shop selling equipment for laboratories. Three dishes of 8-10" (200-250 mm) diameter will cost about Rs.100.00. However, the experiment chulhas with removable parts should be built and kept ready before the course starts. It will also be useful to get some tin chimney pieces of different lengths and diameters. It is easier to use tin chimneys for the experiments because they are lighter. They can be held in place easily.

INTRODUCTION

For the improved chulha to be most useful it is important that it is built and used properly. For both, it is necessary that those who have to spread it understand the principles on which it works. This chapter gives a simple explanation of how fuelwood and other biomass fuels burn, how heat moves and how different parts of the Nada Chulha work. It is hoped that it will be useful to trainers and others working on spreading the chulha. We hope that better understanding will also help them do their own experiments and make the chulha better and more useful.

SECTION I

1. WHAT IS A CHULHA?

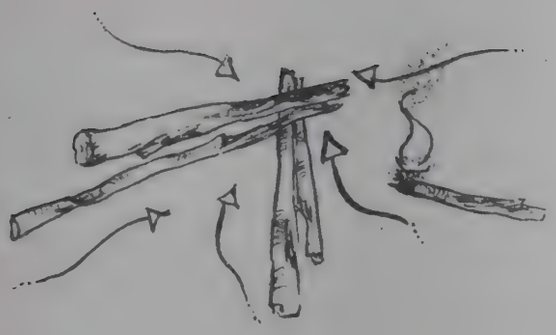
1.1. A chulha is used to change chemical energy from fuel into heat and to move this to the food to be cooked on it. In cold areas, it is also used to keep people warm. In very cold climates, as in the higher Himalayas, the chulha may also be used for heating the kitchen and other parts of the house.

2. BIOMASS FUELS

2.1. Chemical composition of biomass

From a chemical point of view, most fuels from plants are very similar. Their two main parts are cellulose and lignin. The rest consists of minerals. Minerals do not burn. They make the ash which is left after a fuel has burnt. The percentage of minerals (ash) in different types of wood is less than 1.5 percent. However, straw and rice husks, after complete burning, leave behind one fourth of their original dry weight as ashes.

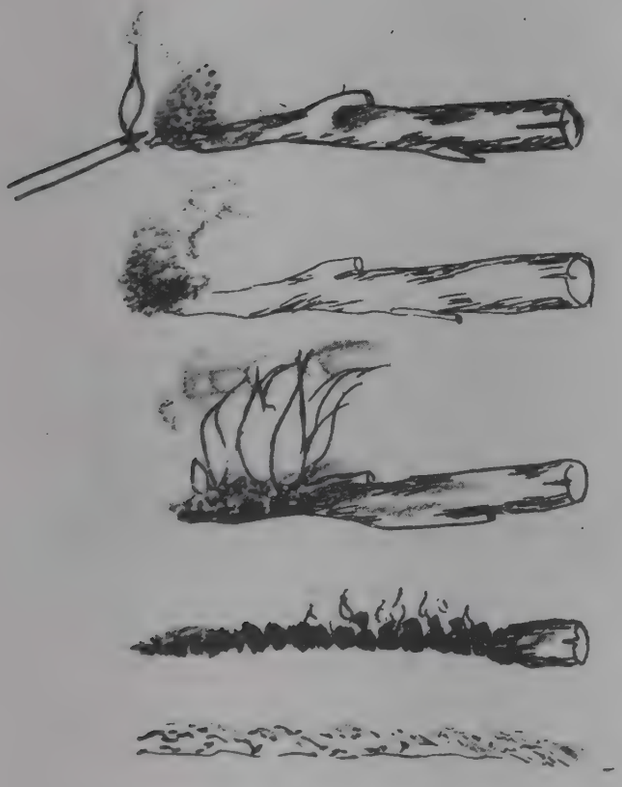
2.2. The **heat content** of a fuel is the amount of heat it can give per unit dry weight on burning completely. This is usually given in terms of calories per kilogram or megajoules per kilogram (MJ/Kg).



2.3. Cellulose makes the major part of plants. Upto 70 percent by weight of dry wood is cellulose. While burning, it is the main source of gases. These gases contain upto 75 percent of the heat content of wood. Lignin, on the other hand mainly turns into charcoal on burning. At higher temperatures, about 80 percent of the wood changes into gases and 20 percent into charcoal.

2.4. All other biomass fuels have more or less the same heat content per unit dry weight. The main difference lies in the shape of various fuels, from large logs of wood to mustard or cotton stalks, rice husks or straw.

2.5. The **burning efficiency** of a chulha is the percentage of the total heat content of the fuel given out during burning. The rest of the fuel's heat is lost due to the fuel not burning completely. As so much of the fuel's heat content lies in the gases, an improved chulha must make it possible for them to burn properly.



3. HOW WOOD (AND OTHER BIOMASS) BURNS.

3.1. Three things are needed to start a fire: fuel, air and heat. By taking away any one of them, a fire can be put out.

3.2. Wood burns like this: when wood is heated it first loses its water. Then its surface in contact with air will start burning. At around 350°C, it starts giving off gases in the form of smoke. At around 550°C, the gases start burning with bright yellow flames. These burn just above the fuel. The flame temperature may reach 1000°C or more. Some of the heat from the flames is radiated back to the fuel heating it even more. As the fire gets hotter, more gases are given off and the fire burns faster. After all gases have been given off, mainly charcoal is left. Charcoal burns with a faint, bluish flame at about 800°C. After the charcoal has burnt, only minerals remain in the form of ash.

3.3. In a real fire, all these processes go on at the same time although in different places. Charcoal may be burning on the surface of a small piece of wood within a minute after it is added to the fire. However, the centre of a

much bigger piece may not even become warm for an hour or more.

3.4. For practical purposes, it is enough to distinguish between two phases of burning, namely that of gases and charcoal. It is only after the flow of gases slows down that most of the charcoal starts to burn.

Air supply to the fire

3.5. A fire cannot burn without air. By controlling the supply of air to a fire we can control the fire itself.

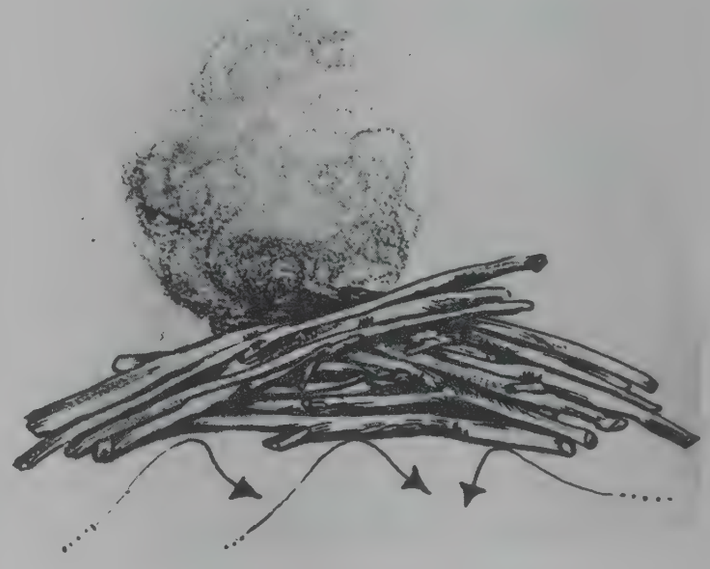
Primary and secondary air

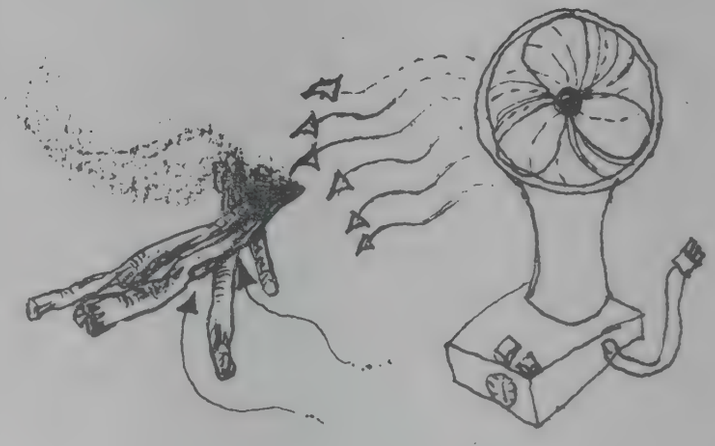
3.6. Primary air is the air that passes through the gaps in the fuel. It is the primary air that makes the charcoal burn. Secondary air is the air pulled in from the surroundings. It is mainly the secondary air that keeps the gases burning.

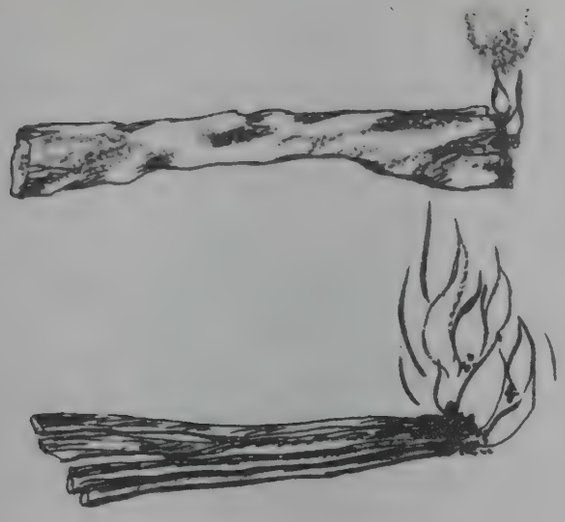
3.7. A supply of both primary and secondary air is needed for proper burning. If the air is too little and does not reach the gases, some of them will escape without burning. Burning with too little air means that fuel is wasted as some gases are lost without giving their heat. If a fire produces a lot of smoke, it could be because of this.

3.8. Upto a point, more air flow makes the fuel burn faster and more fully. Blowing into a fire gives it more air. But too much air may cool the fire so that the gases no longer burn. This also means that fuel is wasted.

Controlling the supply of air to the fire is an important part of an improved chulha design.







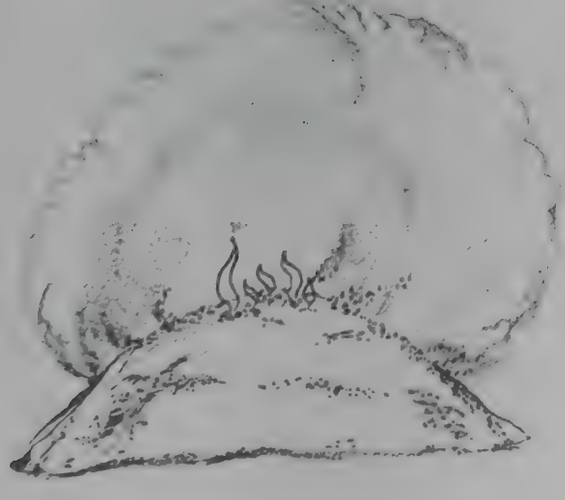
Size, shape and arrangement of fuel

3.9. The heat from wood fires is controlled by the rate of burning of the gases. The rate at which the gases are given off, depends, in part, on the size of the wood pieces. It is easier to light the fire, and make it burn faster, when thick pieces of wood are cut. This is because the area of the wood in contact with air becomes more. Because of that the release of gases is speeded up. More gases result in faster burning.

3.10. For the same reason, a fire of very thin sticks (as of some agricultural residues) will give off big flames for a shorter time than the same mass of thicker wood pieces. To make such fuels burn more slowly they should be compacted. By doing that more even heat will be given which is more useful for normal cooking.

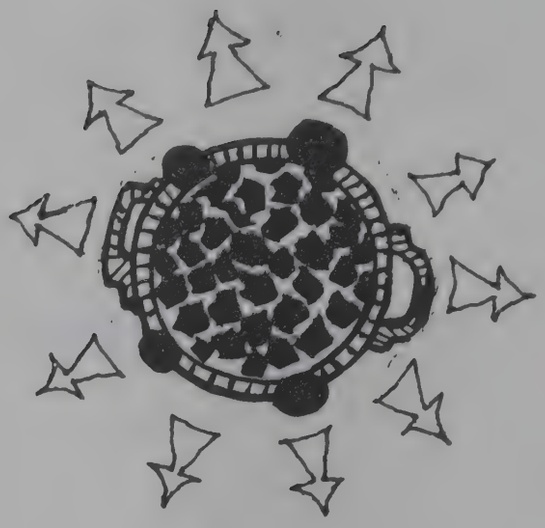
3.11. The fuel has to be stacked so that air can flow freely through it. A heap of saw dust or rich husks burns very slowly because enough air cannot reach the fire. The gases that are slowly given off cannot become hot enough for burning. Instead, they escape in the form of a white to yellowish smoke.

3.12. A large piece of wood may not burn on its own if there is no source of heat from outside (such as other burning wood). This is because too much heat goes into the wood itself. The temperature on the outside is not high enough to make the gases burn.



Moisture in the wood

3.13. Wet wood gives out less heat per unit weight because much of the heat goes into driving out the water. The water in the form of vapour dilutes the other gases. This slows the rate of burning. This also results in a smokier fire which deposits an unburnt tar like substance in the chulha and chimney.



4. HOW HEAT MOVES

Heat can move in three ways: by radiation, by conduction and by convection. When heat moves from a wood fire to a cooking pot, all three ways play a role.

Radiation

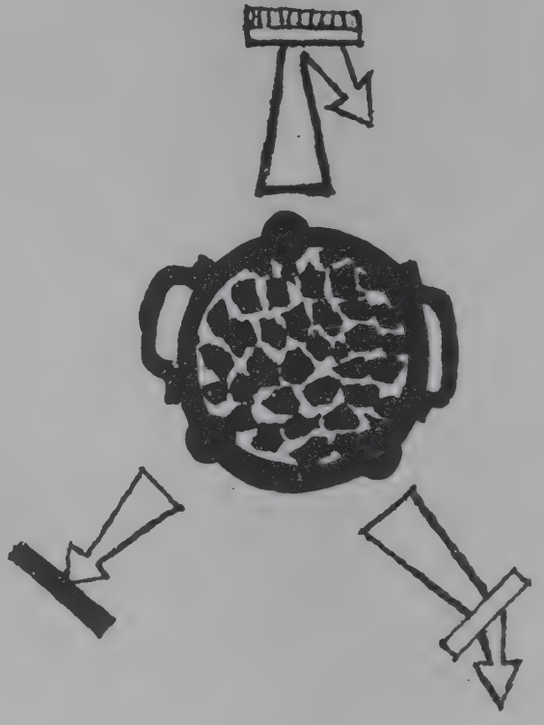
4.1. Radiation is an electro-magnetic form of energy (like light) that is sent out by hot objects.

4.2. Radiation is sent out equally in all directions. An object twice as close to a radiant heat source receives four times as much radiation.

4.3. Radiation increases with temperature difference between the fire and the pot. If the temperature difference is doubled, radiant heat sent out will be increased sixteen times.

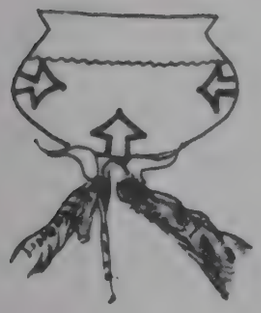
4.4. On reaching the pot, some radiant heat is reflected, some is absorbed by the pot and some by what is in the pot. Shiny things reflect away much of the radiant heat, dark or black things absorb more of it and clear ones pass it on to what is on the other side.

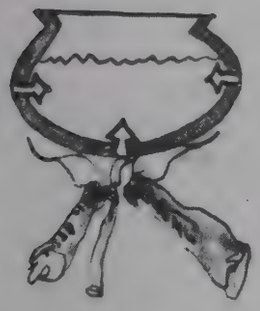
4.5. Most of the radiant heat sent out from a wood fire comes from the glowing charcoal. There is also some radiation from flames. The more the cooking pan bottom can be seen by the fire, the more radiant heat it will get.

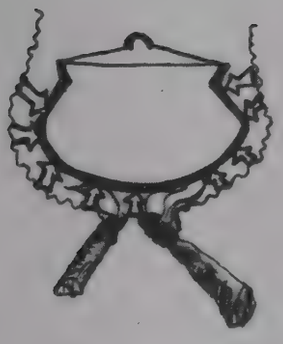


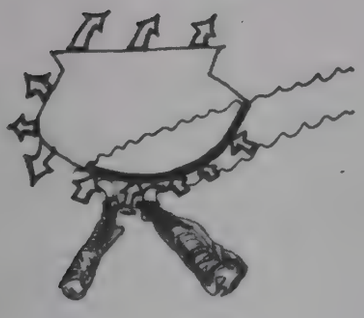
Conduction

4.6. Conduction is the process by which heat moves in solids. In a chulha, conduction is responsible for the movement of heat from the cooking pan to its contents.









4.7. Heat flows quickly through good conductors like steel or aluminium. Poor conductors like wood, clay, cement or air conduct heat slowly. Things with many small air spaces, like straw and sawdust, are also poor conductors.

4.8. Because of this, heat moves faster through metal pots than through clay pots. The thickness of the walls of the pot also determines the rate at which heat moves through them. The heat moving from the fire to the contents of a thick clay pot will be less than through a metal one. That is why cooking food in a clay pot takes more time and uses more fuel.

Convection

4.9. Convection means the movement of heat from a flowing gas or liquid. As the gases given off by a wood fire and the air around them become hotter, they become lighter and rise. Colder and heavier air takes their place at the bottom. This movement of the hot air is called natural convection. When heat is carried away from a fire by the wind or a fan, it is called forced convection.

4.10. In a chulha, heat moves through convection when hot gases and flames flow past the surface of the pot. Thus, if the area of the pot in direct contact with hot gases and flames is increased, the heat moving from the gases to the pot will also increase. Another way of getting more convective heat to the pot is to increase the speed at which the gases go past the surface of the pot.

4.11. Convective heat is also lost through the sides and top of the pan. Heat lost from the top can be made less by using a lid. Heat lost from the sides can be made less by sinking pots inside the body of the chulha.

Efficiency of heat movement.

4.12. The heat movement efficiency of a chulha is the percentage of the fire heat that moves into the cooking pots. The rest is lost in the body of the chulha, to the surroundings or through the chimney.

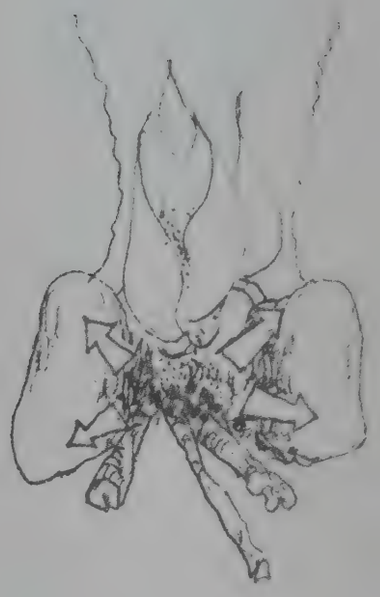
SECTION II

5. THE OPEN FIRE

5.1. The open fire has been used for cooking for thousands of years and is still used a lot in many parts of the world. Let us look at how it works before dealing with the Nada Chulha.

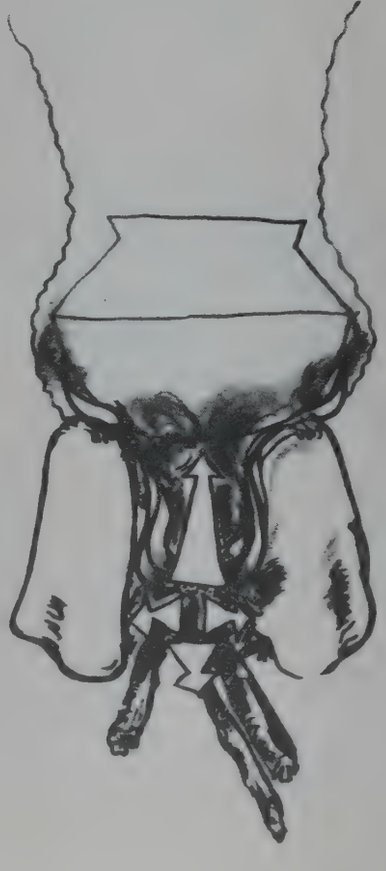
5.2. To start an open fire, pieces of fuelwood are arranged loosely to allow air to pass through the fuel. The air comes from the surroundings.

5.3. Once the fire is burning, it starts radiating heat. If there is no wind, a column of hot gases, some of which are burning, can be seen rising above the fire. This column of hot gases gets cooler the further away from the fire it is.



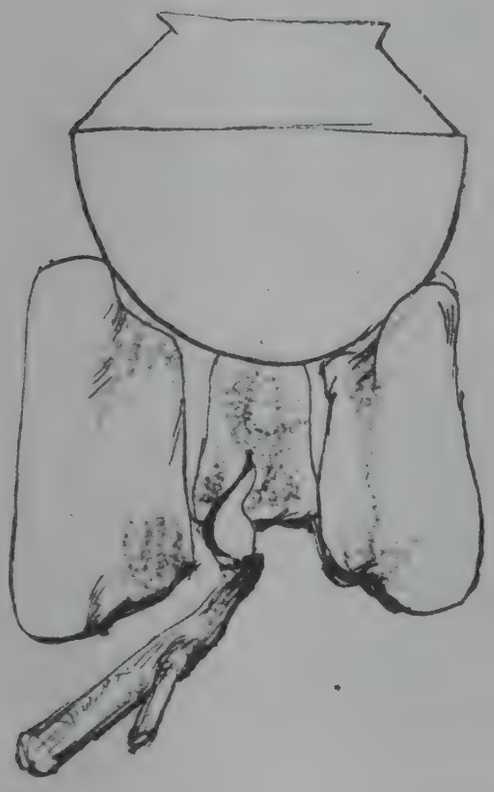
5.4. A cooking pot is normally supported above the fire either on 3 stones or on an iron ring. The height at which the pot is placed is important. To a large extent, the height determines the efficiency with which the fuel will burn and the amount of heat that will go to the pot.

5.5. The pan bottom receives only a small part of the radiant heat from the glowing charcoal. Some of it goes to the 3 stones and the ground and the rest is lost to the surroundings. However, the flames and hot gases (and smoke) flow around the pot, which gets convective heat from its bottom and sides.



5.6. If the pot is moved closer to the fire, it gets more radiant heat and perhaps more convective heat also. But, if the pot is too close, the fire might even go out. This is because enough air cannot reach the gases.

5.7. The best you can do is to place the pot at such a height that you get a good fire and at the same time a good amount of heat going to the pot.



5.8. The size (diameter) of the fire should be related to the size of the pot. If the fire is too small, there is not enough heat. If it is much bigger than the pot, a lot of heat (and fuel) is wasted.

Advantages of the open fire.

5.9. The open fire has many advantages. It does not cost anything, you can easily see the fire, and to some extent also control it. The heat from the fire can be made more or less by adding or taking away some fuel. It gives both heat and light.

Drawbacks of the open fire

5.10. The open fire, however, also has many drawbacks. Its smoke affects the health of the housewife and makes cooking difficult work. Walls and ceilings become black and soot falls on household goods. It can cause fires. Small children can easily get burnt. In hot climates, the cook has to suffer the heat of the fire. Pots become black all over. The open fire has to be looked after all the time.

5.11. Finally, when it is windy, the open fire is difficult to light and manage. The wind blowing through the fire makes it burn better. The additional heat is, however, blown away from the pot. The pot starts loosing heat instead of getting it. Because of this, a lot of fuel is wasted.

6. TRADITIONAL CHULHAS

6.1. In most parts of rural India today, the open or 3-stone fire is not very common. It is used only by homeless people in cities or by the rural population living in remote and backward areas.

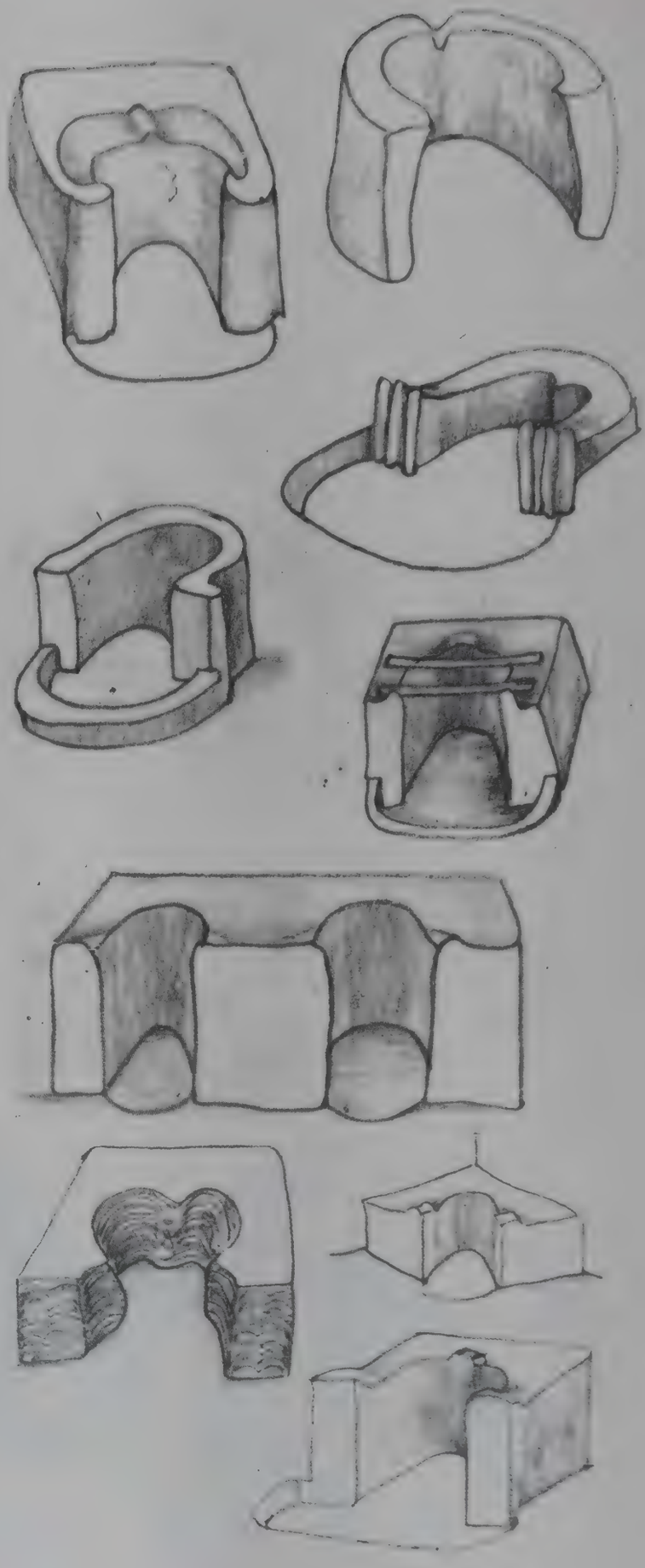
6.2. In other areas, people have given up the open fire. Instead, they have developed many types of traditional chulhas. The designs of these show the users' needs and priorities. Below we look at some common traditional chulhas used in Haryana, Punjab, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Maharashtra, Bihar and Meghalaya. Other parts of India must have still other types.

The U-shaped Chulha.

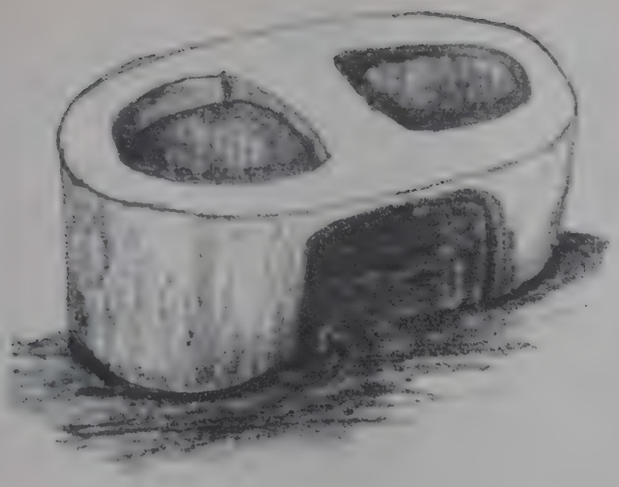
6.3. This consists of a U-shaped enclosure for the fuelbed with three humps on the top. This is the most common traditional chulha in the north Indian plains. Air for the fire comes in from the open front. Hot gases and flames move out around the pot through the gap between the pot and the humps. The U-shaped chulha can be fixed or movable.

6.4. The U-shaped chulha is made of brick, stone, clay or a mixture of these. The width and depth of the enclosure are related to the sizes of pots used in the kitchen. The height from the floor of the chulha to the top of the humps can be 5" (125 mm) to as much as 15" (375 mm). Because of this, the amount of heat reaching the pot can be very different in different chulhas. The movement of convective heat into the pot is like in an open fire.

6.5. The U-shaped chulha seems to have been designed to protect the open fire from wind and reduce the danger of accidents of burning and fire. But it still has most of the problems of the open fire.



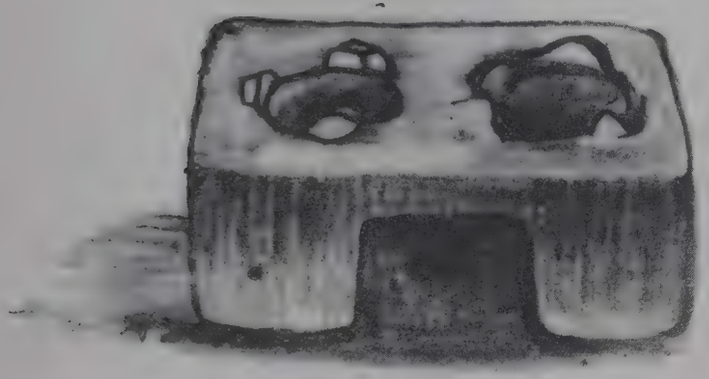
Different shapes and sizes of the U-shaped chulha.

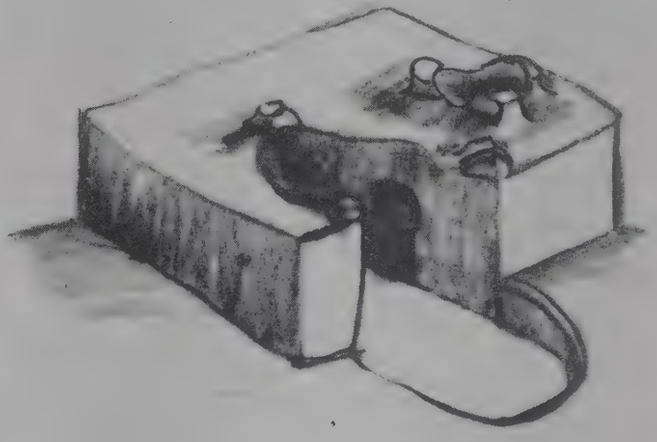


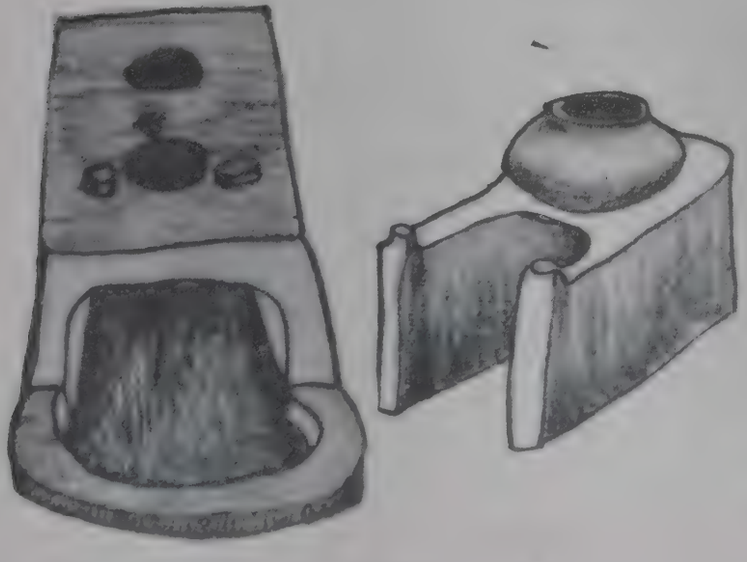
2-holed traditional chulha.

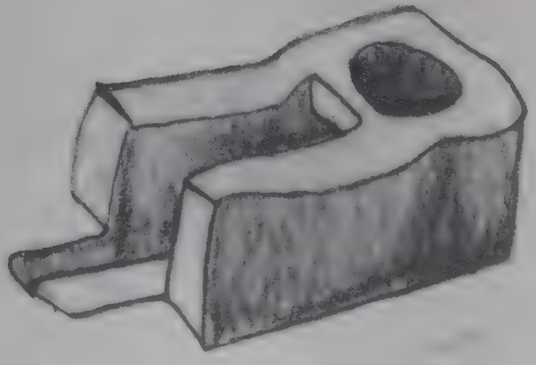
6.6. The 2-holed traditional chulha is also very common in the plains and hills. It also has a U-shaped enclosure for the fuel. This is connected by a tunnel to a second cooking hole with humps. In most areas, even the first hole has humps. In some parts of H.P. the first hole does not have these and the firebox opening is also bridged over.

6.7. The main advantage of the 2-holed chulha is that the housewife can cook or warm two items at the same time. This can reduce the time spent on cooking. Also, some of the heat in the hot gases and flames which goes waste in the U-shaped chulha can be used for the second pot. This can save some fuel. The illustrations show some of the regional variations in shapes and sizes of the 2-holed traditional chulha.





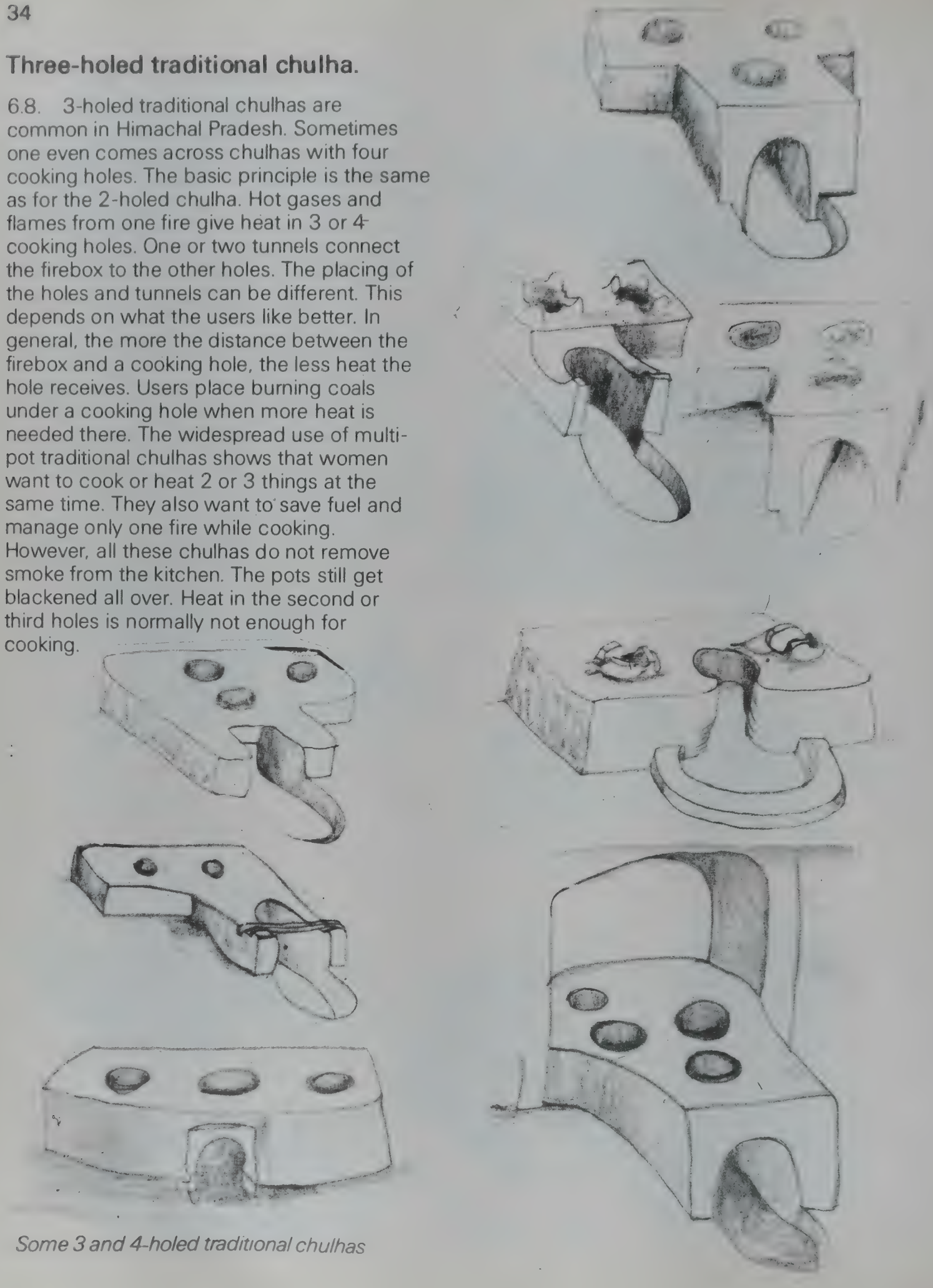




2-holed traditional chulhas

Three-holed traditional chulha.

6.8. 3-holed traditional chulhas are common in Himachal Pradesh. Sometimes one even comes across chulhas with four cooking holes. The basic principle is the same as for the 2-holed chulha. Hot gases and flames from one fire give heat in 3 or 4 cooking holes. One or two tunnels connect the firebox to the other holes. The placing of the holes and tunnels can be different. This depends on what the users like better. In general, the more the distance between the firebox and a cooking hole, the less heat the hole receives. Users place burning coals under a cooking hole when more heat is needed there. The widespread use of multi-pot traditional chulhas shows that women want to cook or heat 2 or 3 things at the same time. They also want to save fuel and manage only one fire while cooking. However, all these chulhas do not remove smoke from the kitchen. The pots still get blackened all over. Heat in the second or third holes is normally not enough for cooking.

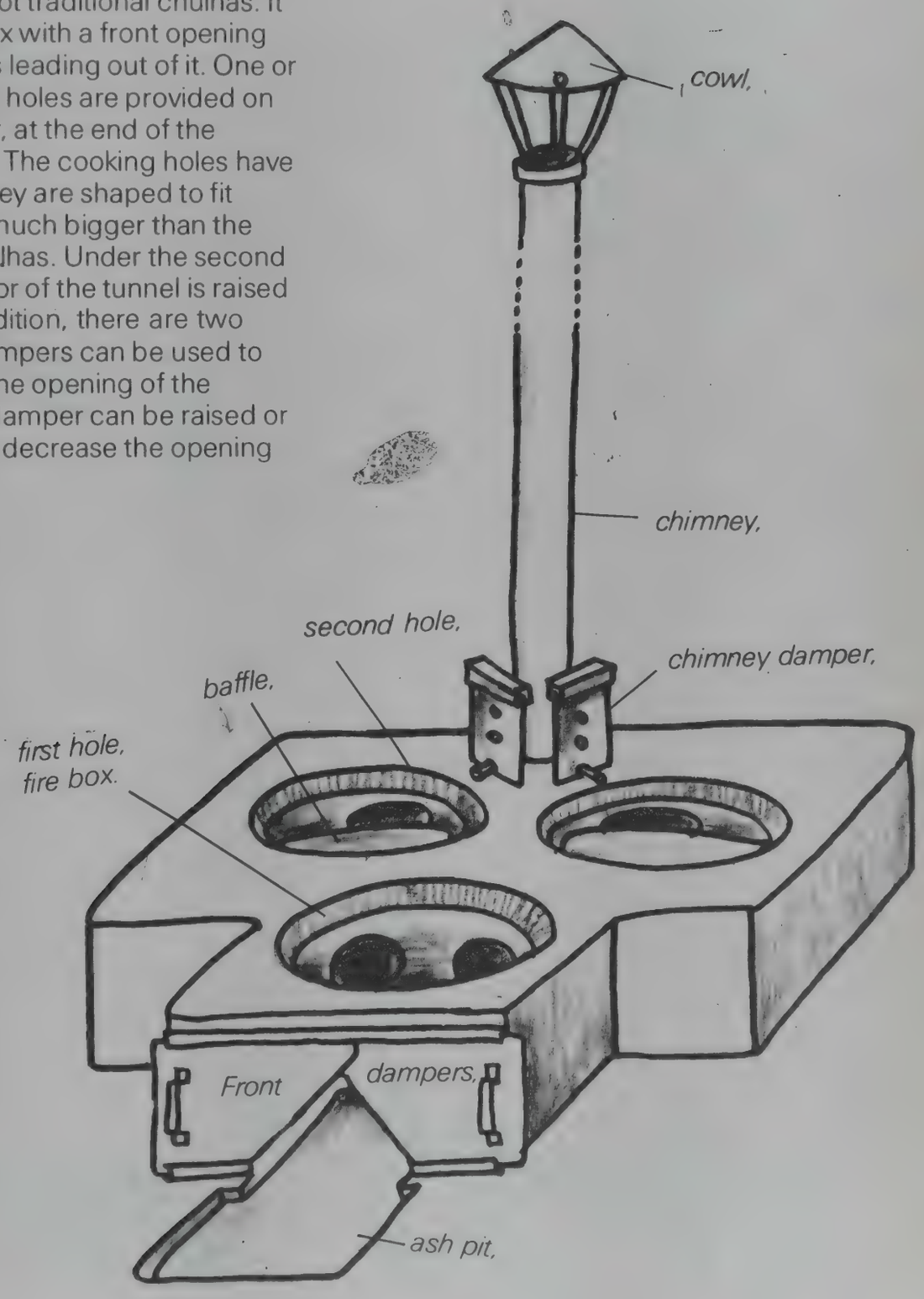


Some 3 and 4-holed traditional chulhas

SECTION III

7. DESIGN COMPONENTS OF THE NADA CHULHA

7.1. On the surface, the Nada Chulha seems quite similar to multi-pot traditional chulhas. It has an enclosed firebox with a front opening and one or two tunnels leading out of it. One or two additional cooking holes are provided on the tunnel(s). However, at the end of the tunnel(s) is a chimney. The cooking holes have no humps on them. They are shaped to fit cooking pots and are much bigger than the holes of traditional chulhas. Under the second and third holes, the floor of the tunnel is raised to form a baffle. In addition, there are two dampers. The front dampers can be used to increase or decrease the opening of the firebox. The chimney damper can be raised or lowered to increase or decrease the opening of the tunnel.



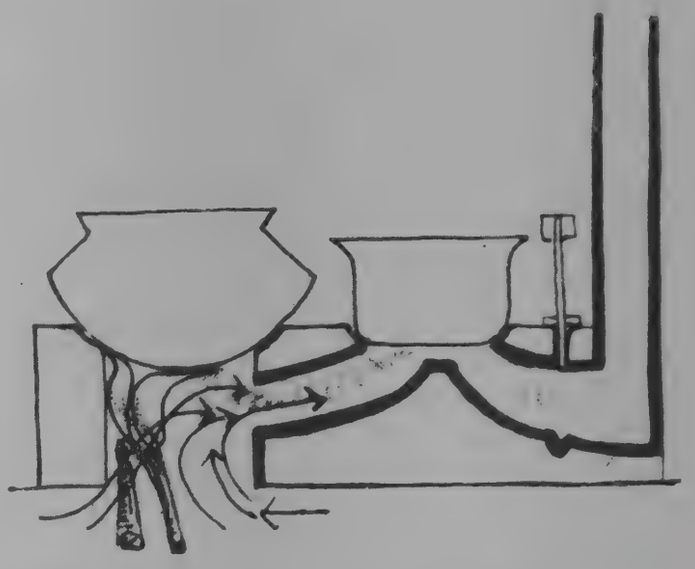
A 3-holed Nada Chulha with 2 tunnels.

The Chimney

7.2. The chimney is the most important part which makes the Nada Chulha different from traditional ones. The chimney is not just a means of removing smoke. It also pulls in air through the firebox. The chimney has an important effect on how the chulha works. It also determines the relationship between all other parts of the chulha. The burning and heat movement efficiencies of a chulha with a chimney can be better than those of a traditional chulha. But these can also become worse if the chulha is not built properly.

The chimney and draft

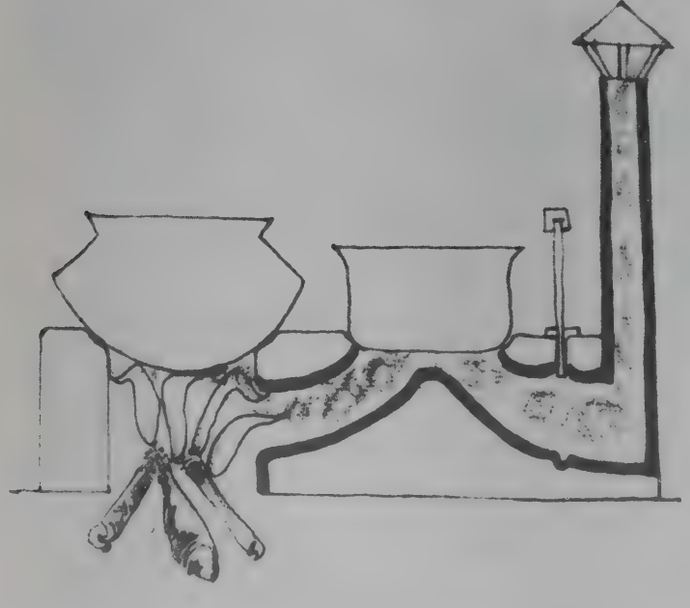
7.3. The force that pulls smoke and hot gases through the chimney is called draft. It occurs because the hot gases from the fire are lighter than the surrounding air and therefore rise. The space left by the rising gases is filled by colder and heavier air coming in through the firebox mouth. Due to this, in addition to removing smoke, the chimney can also make enough air available for better burning of the fuel.



The chimney pulls in air through the chulha

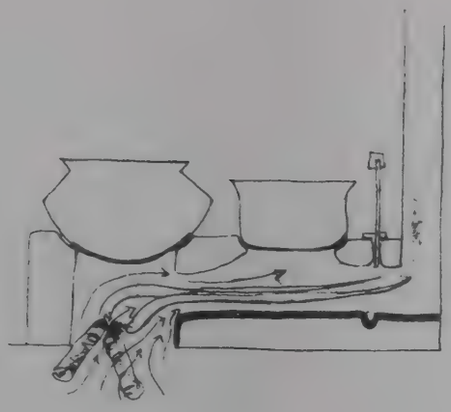
Factors affecting draft

7.4. Generally, the more is the height and the diameter of the chimney, the more is the draft.



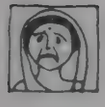
Too little draft with a small chimney.

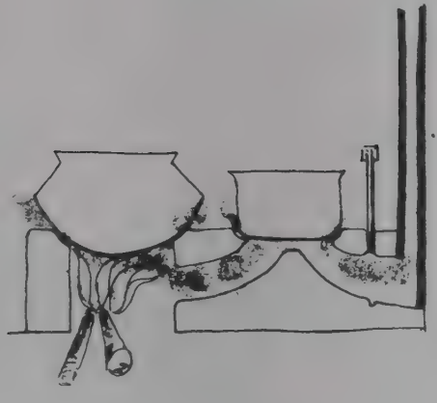
Too much draft with a big chimney.



7.5. Draft increases if there is more difference in temperature between the bottom and top of the chimney. For the same reason, provided there is no wind, there will be no draft if the temperature of the gases at chimney bottom is the same as outside air temperature. Draft can be started in a cold chulha by placing a burning piece of paper at the bottom of the chimney. In a chulha with a chimney, some of the fire heat **has** to be lost up the chimney to maintain the draft.

7.6. Too strong a draft may pull in more air than the fire needs. This will make the fire burn faster and increase fuel consumption. However, the strong draft will pull the flames away before they touch the first pot. When this happens, much of the heat from the fire is wasted as it just goes out through the chimney. You can reduce the draft by placing some obstruction in the chimney or the tunnel.



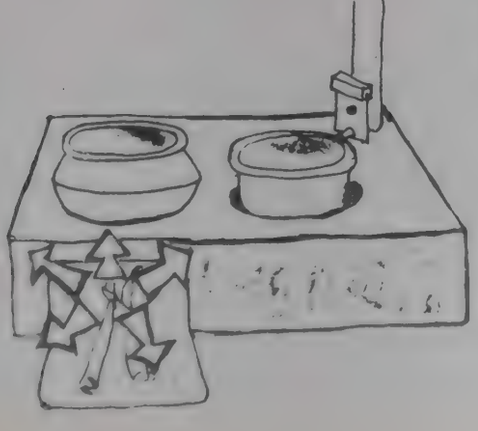


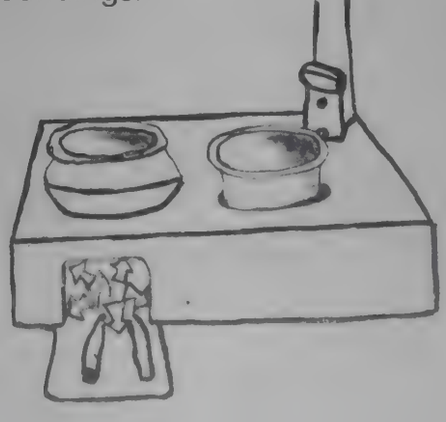
7.7. If the draft is too low, the fire will not burn well and a lot of smoke will be produced. Some of this smoke might come out from the chulha through gaps around the pots and through the firebox mouth.

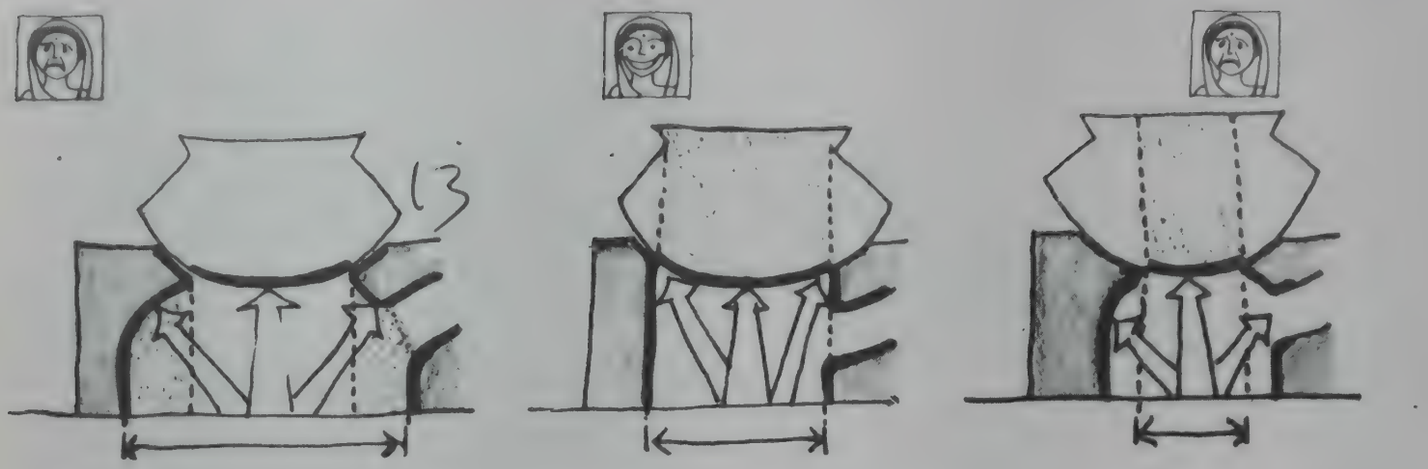
7.8. The chimney size must be selected carefully in relation to the size and design of the chulha.

Firebox

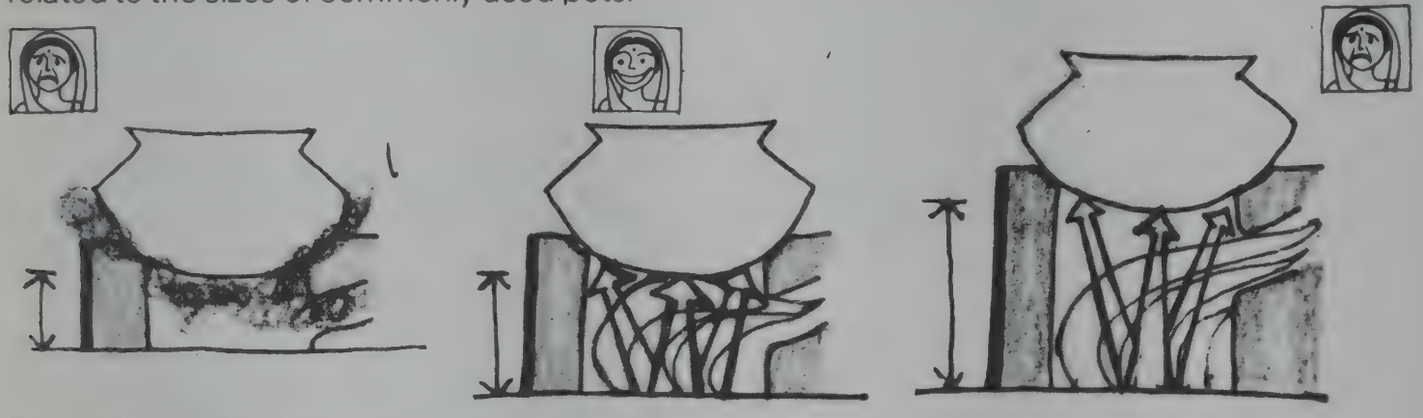
7.9. The firebox is that part of the chulha where the fire burns. The front opening of the firebox has two functions: providing air to the fire and putting in the fuel. The opening should be large enough to feed the fuel with ease and also place it properly. However, it must not be so large that too much heat of the fire is lost to the surroundings.





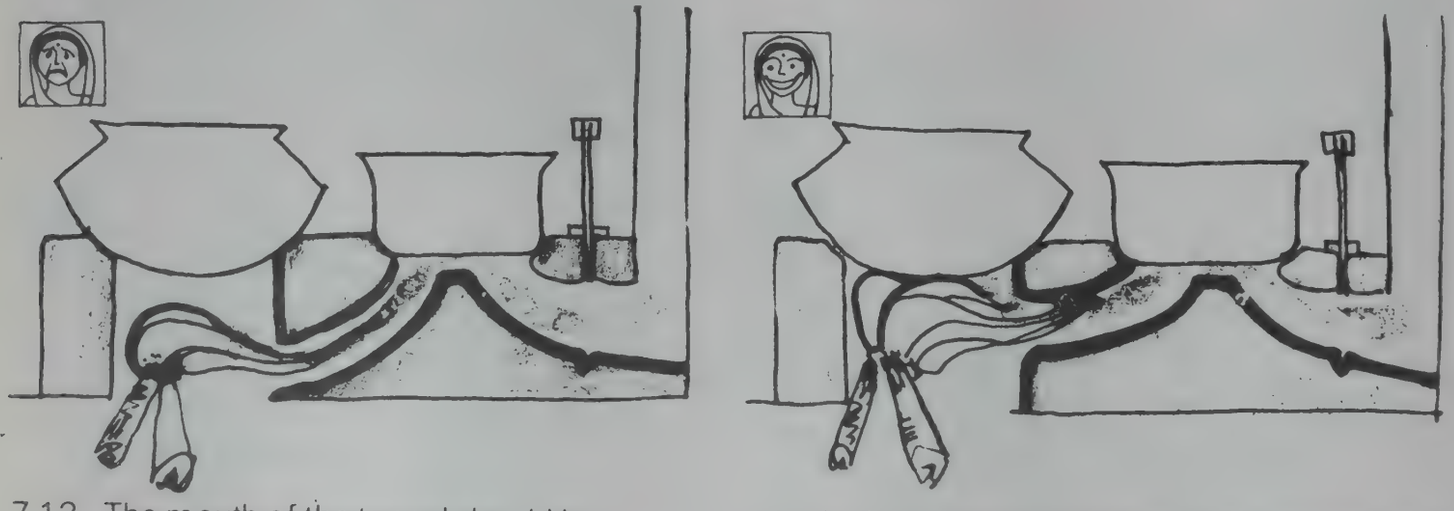


7.10. The firebox must be large enough for the size and type of fuel used but small enough to keep the fire under the pot. The width and depth of the firebox should be related to the sizes of commonly used pots. The diameter of the cooking hole above it should be as large as possible. A bigger cooking hole will mean that more area of the pot bottom will receive heat from the fire.

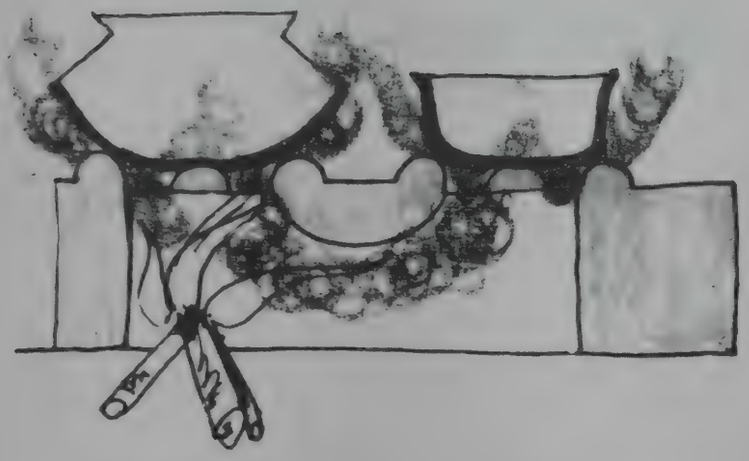


7.11. The height of the firebox, (the distance between its floor and the pot bottom) should be so small that a maximum of radiant and convective heat from the fire can reach the bottom of the pot. Yet it should not be so small that the fire cannot burn because not enough air can reach the gases.

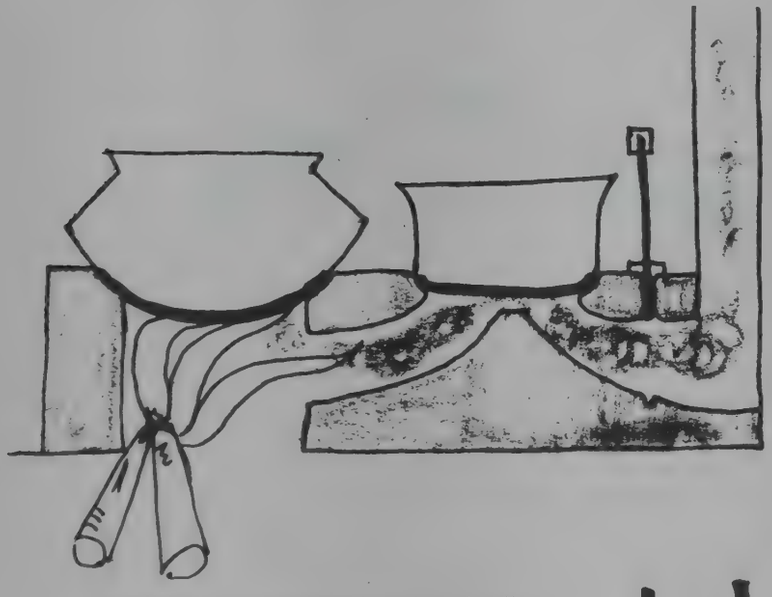
7.12. If the firebox is too high, less radiant heat will reach the pot. The flames will also be pulled away by the draft before they have touched the pot.



7.13. The mouth of the tunnel should be placed near the top end of a wall of the firebox. When there is too much draft, this will stop the hot gases and flames from leaving the firebox without first touching the pot bottom.



Tunnel of a traditional 2-holed chulha.



Tunnel of 2-holed Nada chulha

Tunnel connecting the firebox to the chimney.

7.14. In the Nada Chulha, the tunnel connecting the firebox to the chimney has two functions:

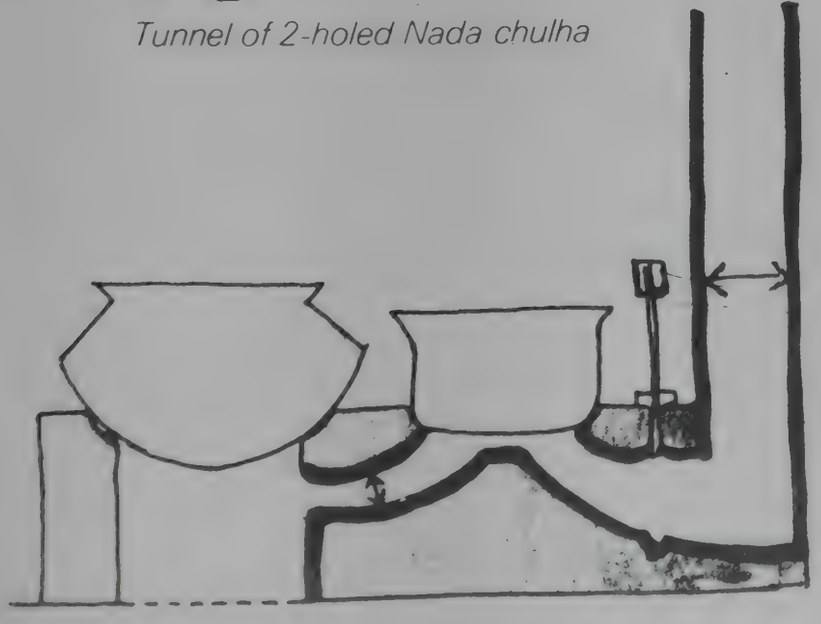
1. to take the smoke from the fire to the chimney;
2. to lead the heat from the fire to the second and third cooking holes.

It is different from the tunnel of a multi-pot traditional chulha. In the Nada Chulha, the tunnel is the **only** way for the hot gases and smoke to go out. Also, because of the draft, the gases move through at a high speed. The hot gases also carry a lot of heat of the fire.

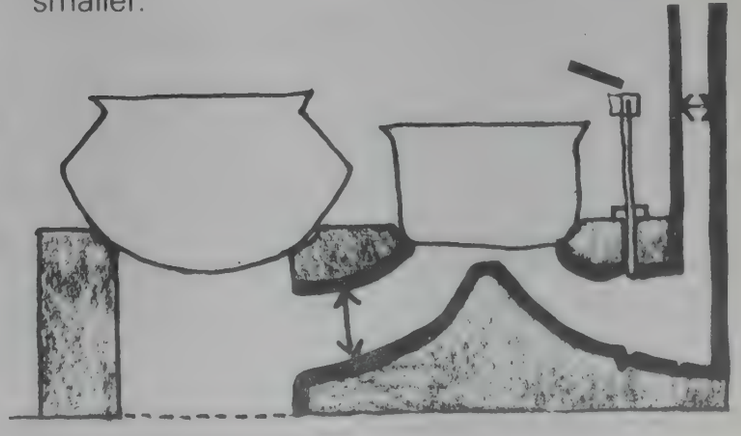
7.15. The tunnel, therefore, is designed to take out a maximum of this heat before the hot gases and smoke go up the chimney. One or two more cooking holes are placed on the tunnel to take out more heat. The tunnel should be long enough to accommodate the holes.

7.16. However, the tunnel should not be so long that the smoke and gases become cold before reaching the chimney. Too much length will also increase the flow resistance of the tunnel. Both can reduce the draft to less than that required. To some extent this can be balanced by increasing the height and/or the diameter of the chimney.

7.17. If the chimney diameter is too large for the size of the chulha, the draft can be reduced by making the diameter of the tunnel smaller.



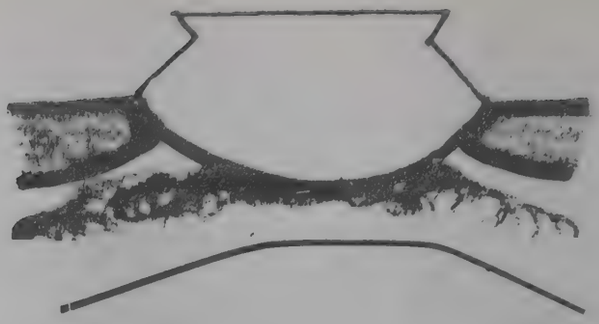
If the chimney is too wide, the tunnel can be made small.



If the chimney is too narrow, the tunnel can be made bigger.

Shape and diameter of cooking holes.

7.18. Cooking holes of the Nada Chulha are shaped to fit the pots so that no smoke can leak from around the pots. In some respects this places this type of a chulha at a disadvantage compared to traditional chulhas. The fitting cooking holes mean that pots can receive heat only from the bottom. The best way out is to make the diameters of all cooking holes as big as possible in relation to the most used pots.

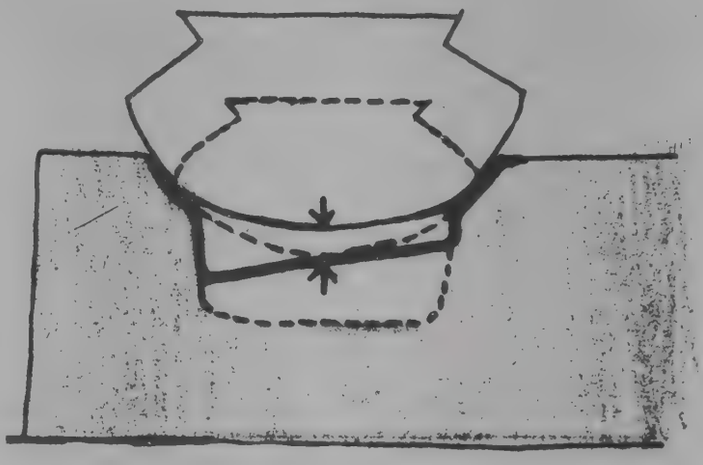


7.19. At the point where the tunnel roof opens into a cooking hole it should be as thin as possible. Too much roof thickness will keep the hot gases away from the pot and the pot will receive less heat.

7.20. To reduce the loss of heat from the sides of pots, the holes are shaped to partly sink the pans inside the chulha. Pots sunk into the chulha will also receive more heat from the hot chulha. However, this does not work well where rotis are eaten every day. The tava on which rotis are made has to be kept on the top of the chulha.

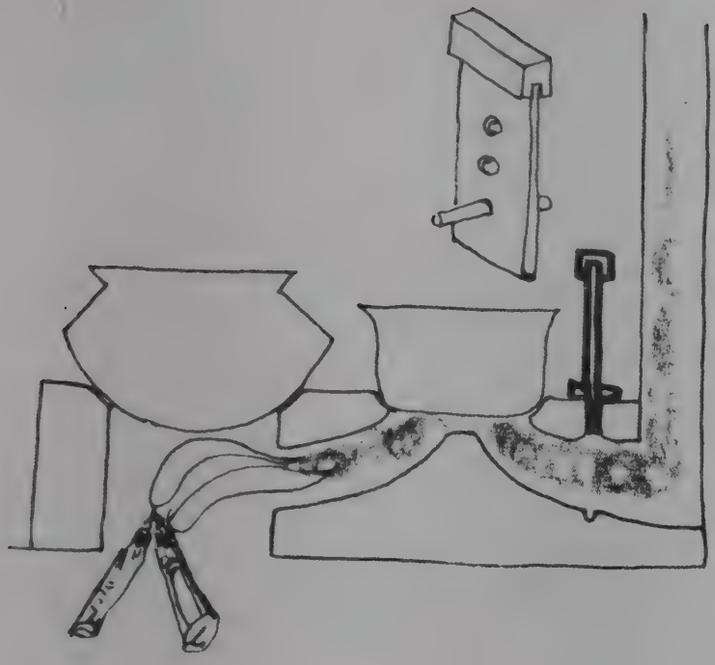
Baffles under cooking holes.

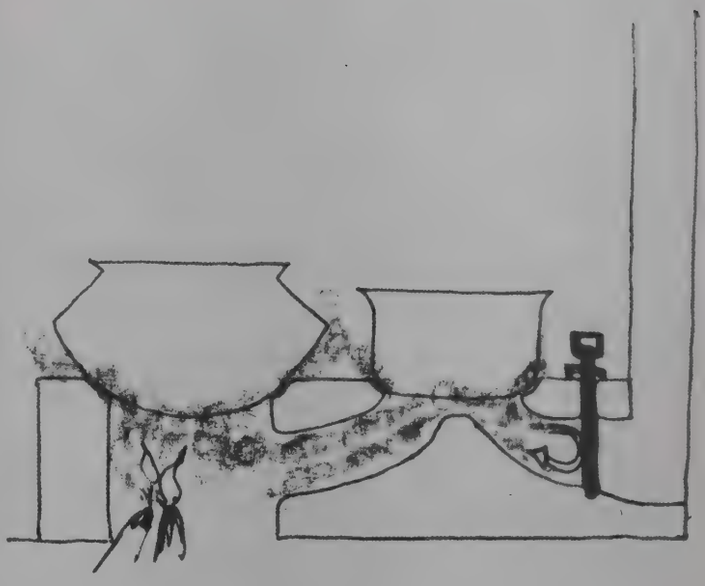
7.21. Baffles are obstructions built in the tunnel. These are provided under all cooking holes except the one over the firebox. Baffles force the hot gases and flames to hit pot bottoms at high speed. This increases the heat the pots receive from the hot gases.

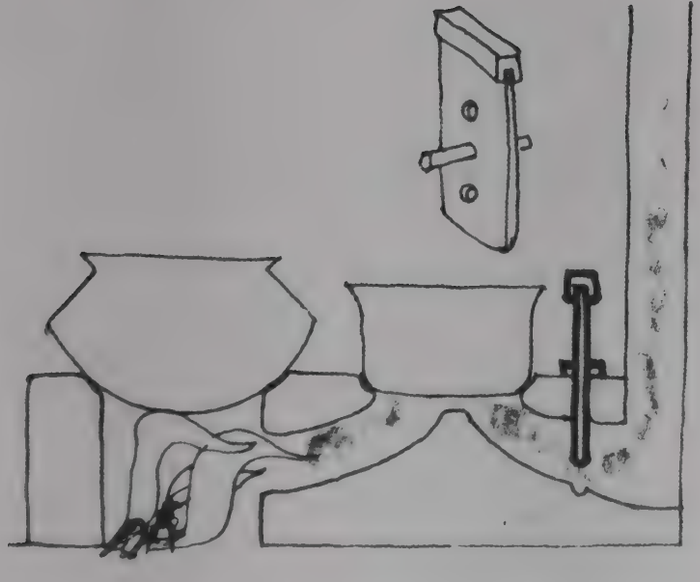


7.22. The distance between the bottoms of all pots used on the chulha and the baffles should be the minimum necessary to maintain enough draft. This has been found to be around 3/4" (20 mm). This, however, is not always possible. Most families have pots of different shapes and sizes. If the gap is the best for one pot, it becomes too much or too little when a different pot is used. What is worse, if a small pot with a round bottom is placed in a hole meant for a big pot with a flat bottom, it can touch the baffle and block the tunnel completely.

7.23. The best way out is to make the gap suitable for the most used pot and make the baffle slightly higher from one end and lower from the other. The lower end should be on the side of the tunnel with a longer route to the chimney. If this is done, the tunnel will not get blocked completely even when a small pot touches the centre of the baffle. There will always be some gap on one side. If the gap between the baffle and some other pans is too much, the draft should be reduced by lowering the chimney damper.







Chimney damper.

7.24. The chimney damper is placed between the last cooking hole and the chimney. The chimney damper can be pulled up or pushed down. When pulled up, the passage to the chimney is totally clear. When pushed down, the passage is completely blocked. By placing the chimney damper in in-between positions, the draft of the chimney and the heat of the fire can be increased or decreased.

7.25. For a low fire, the chimney damper should leave only a small opening in the tunnel. When a strong fire is burning, lowering the chimney damper does not produce a quick and visible effect on the fire. This is because the lowered damper reduces the air reaching the fire. But because the fire is very hot it keeps on releasing gases till it has become less hot. This takes some time. Less air supply, however, does not let the gases burnt properly. To reduce the time taken by the fire to cool down, some fuel should be taken out. The heat of a wood fire cannot be increased or decreased at once as with a gas fire.

Front dampers.

7.26. The front dampers consist of two sliding metal doors with their inner sides cut at an angle of 45°* Because of this the dampers can close around even long pieces of fuelwood. The front dampers have four functions:

1. to control the amount of air entering the firebox;
2. to reduce loss of heat from the fire to the outside;
3. to reflect heat back on the fire, and
4. to protect the cook from the heat of the fire in hot climates.

7.27. By keeping front dampers open when starting a fire, the fire can be given enough air. Once the fire is burning and the chimney draft has started pulling in air, the front dampers should be closed almost fully.

*This design of the front dampers was developed by the Dhauladhar Chulha team of the Indo-German Dhauladhar Project, Palampur, H.P.

Because of this too much cold air will not enter the firebox. The temperture inside will rise and the gases will burn better. A smaller firebox opening also reduces radiant heat lost to the environment.

Control of fire heat

7.28. By using the front and chimney dampers, the rate of burning and the heat of the fire can also be increased or decreased. It is important to control the heat of the fire to reduce fuel consumption. While bringing water or food to the boil, strong heat is needed. Once food has started boiling, the fire heat should be reduced a lot. During simmering, only enough heat to maintain the boiling temperature is needed. Too much heat during simmering only dries more water and wastes fuel. It does not make the food cook faster.

Remember that savings in fuel consumption depend a lot on how the chulha is used and the type of food which has to be cooked. An improved chulha can only *help* a user to save fuel.

Chapter 4

HOW TO BUILD THE IMPROVED NADA CHULHA

This chapter tells about the Nada Chulha system and the construction method which can be used to build chulhas of different shapes, sizes and types. To make it easier to use the chapter during training sessions, it has been divided into four sections. Each section can be covered in one session. Before each session, instructions to trainers on how to conduct the session have been given.

SECTION I

This is about tools and materials required and how to make *gara* (clay with additives) and *chaapris* (pre-fabricated mud slabs). All this can be covered during one morning or afternoon session of 2 to 3 hours. This session should be held on the first or second day of the course. The trainees should have already seen a chulha being built before this. Due to that, they will understand better what is taught and relate it to chulha construction. All tools and materials and some water, buckets and mugs should be kept ready. The clay for making gara should be soaked the night before. A set of tools can be given to each trainee during this session. They will use these during the rest of the course. After introducing tools, materials and how important it is to make good gara and chaapris, the trainees should make gara and chaapris under close supervision. Each trainee can be asked to make chaapris for one chulha.

1. TOOLS AND MATERIALS

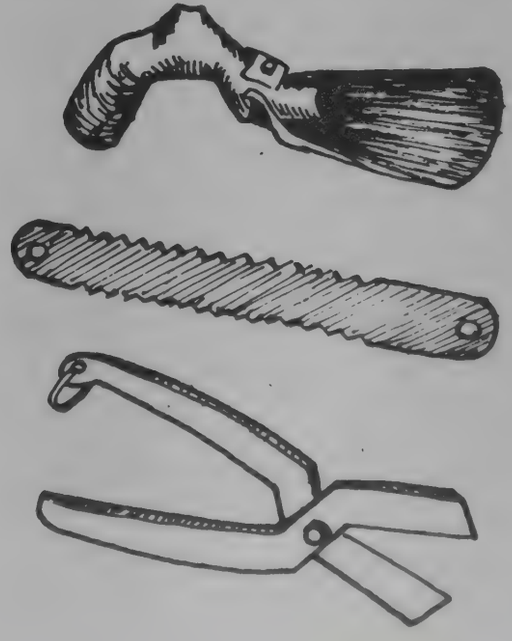
1.1. Tools Required

Only a few simple tools are needed for building the Nada Chulha. These are:

1. A *Khurpi,* which is normally available in most village homes, for cutting *chaapris* to required sizes. Any other sharp edged tool can also be used.

2. In areas where asbestos cement chimneys are used, a hacksaw blade for cutting holes in chimneys.

3. A metal sheet cutter for making small changes in dampers and guides.



4. A measuring tape.

5. A simple rectangular mould for making mud slabs. In the Nada area these are called *chaapris*. In areas where bigger chulhas will be made, the internal dimensions of the mould can be 21"(525 mm) long, 7" (175 mm) wide and ¾" (20 mm) thick.

Where smaller 2-holed chulhas are more common, the internal dimensions of the mould should be 15" (375 mm) long, 7" (175 mm) wide and ¾" (20 mm) thick.

1.2. Materials needed

The following materials are needed for building a Nada Chulha:

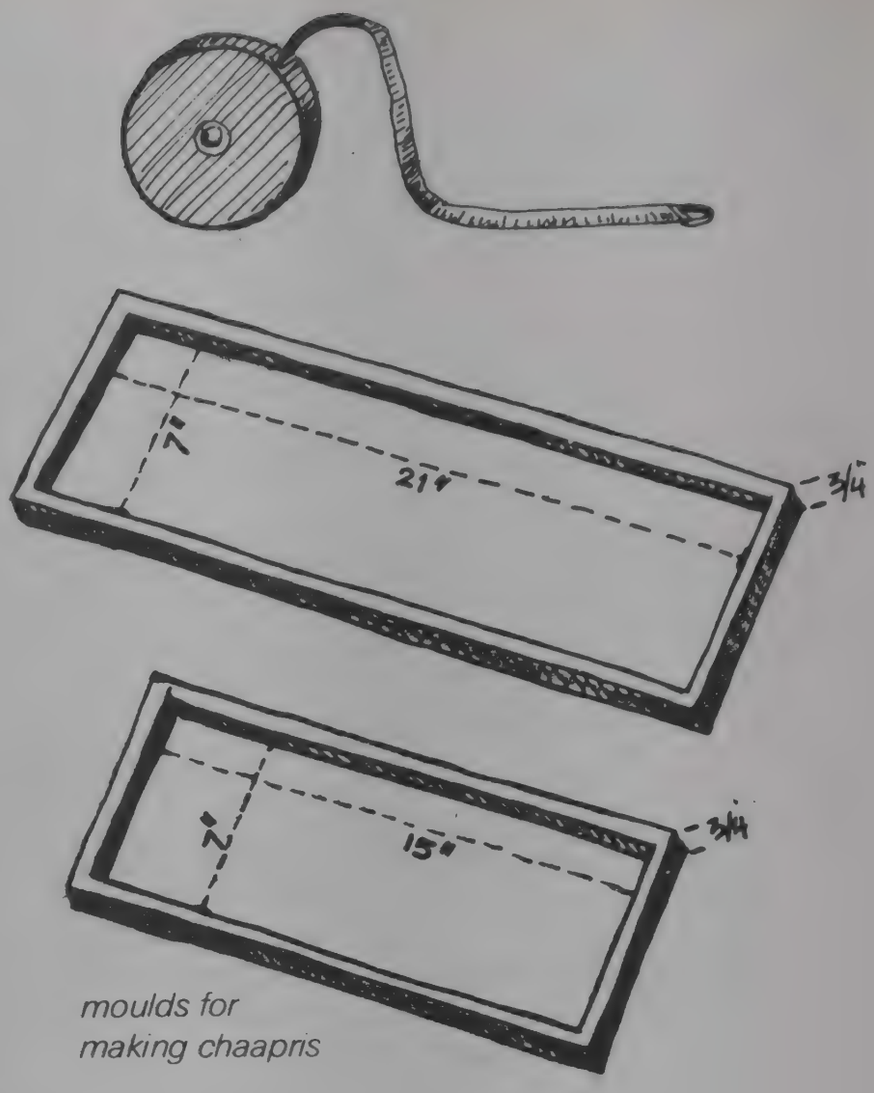
1. Gara (clay with additives)
2. Dry soil
3. Metal dampers
4. Chimney and cowl
5. A metal strip or iron rod.

1. Gara: The chulha and chaapris are made with gara. For this good clay is needed. Approximate quantities for different chulha types are given in Chapter V.

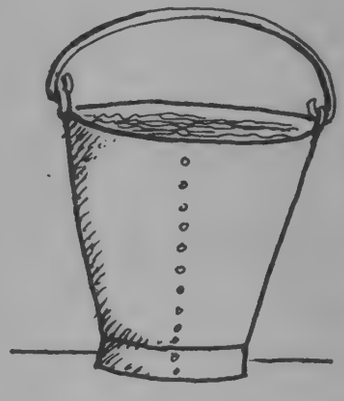
Some fibrous material should be mixed with the clay to increase its strength and stop it from cracking. This is different from area to area. It depends on what is available and the quality of the local clay. There is no standard or perfect mix for gara. For finding out the best mix, local women should be asked what they use for building traditional chulhas. Traditional mud chulhas are built in most parts of the country. Over generations, local women have found out which is the best clay near their villages and what should be mixed with it. The mix can be made still better with experience and experiments. Some of the combinations used are:

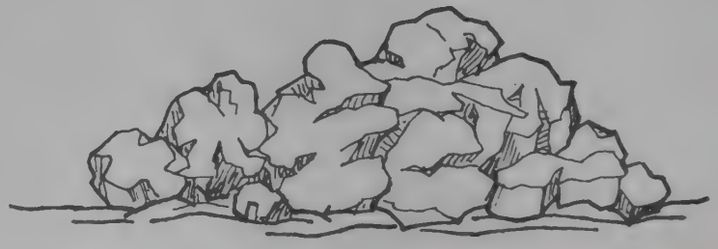
In Nada and Sukhomajri in Haryana, equal amounts (by volume) of very good local clay and finely chopped paddy or wheat straw are used to make gara. Paddy straw is better than wheat straw. Sometimes, the fibrous bhabbar grass is used for even stronger gara.

In villages near Indore, sieved ash, powdered burnt brick, some sand and



moulds for making chaapris



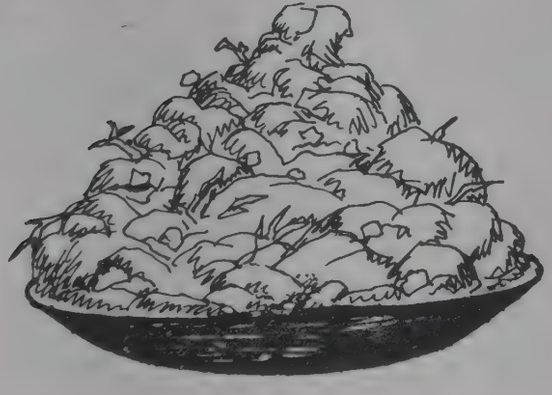


chopped straw are mixed with local black soil to make strong gara.

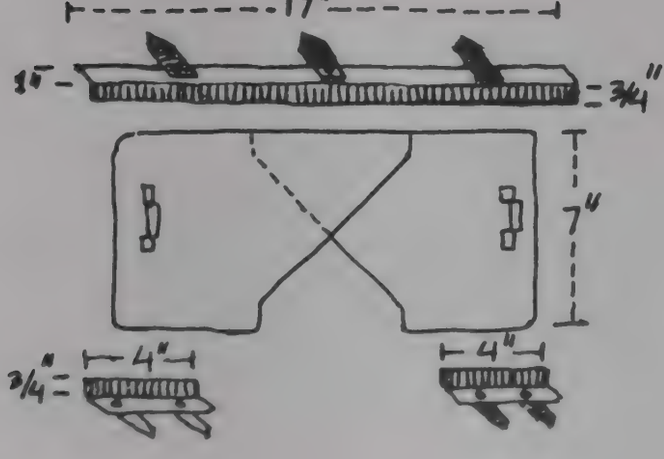
In parts of Himachal Pradesh, a mixture of clay, straw and cow or mule dung is used. Where straw is not available, chopped pine needles or small pieces of hessian sacks are mixed with the clay. Sometimes sand is also added.

It is useful to find the best clay and what should be added to it to make good gara. The strength and finish of the chulha depends on it.

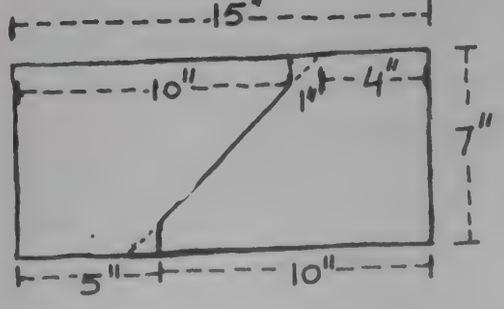
2. Dry Soil: This can be ordinary earth from the fields. It is used for filling hollow spaces between chaapris. This helps chulhas to dry faster and reduces the amount of gara required.

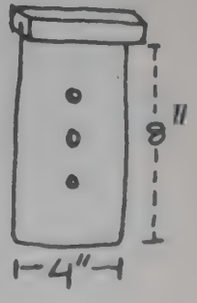


3. Metal dampers: The chulha uses a front damper and a chimney damper. The front damper has two sliding doors and 3 guides. The chimney damper is of simple rectangular shape. Some chulhas need two chimney dampers. The dampers should be made of stiff metal sheet of 22 to 24 gauge thickness. The sheet should be thick enough to not bend easily. Too much thickness will only increase cost. Too thin a sheet could be dangerous as it can cut hands. Normally, dampers will be supplied to chulha mistris by project authorities. The sizes and shapes of both dampers are shown in the drawings. Any sharp corners of dampers and guides should be cut off.



how to cut dampers





chimney damper

4. Chimney and Cowl: For a 2-holed domestic Nada Chulha, a 3 inches (75 mm) diameter chimney is needed. For a 3-holed chulha, especially in high mountain areas, a 4 inches (100 mm) diameter chimney should be used. The length will depend on the height of the kitchen. It should be enough to take the chimney 2 feet (600 mm) above the roof.

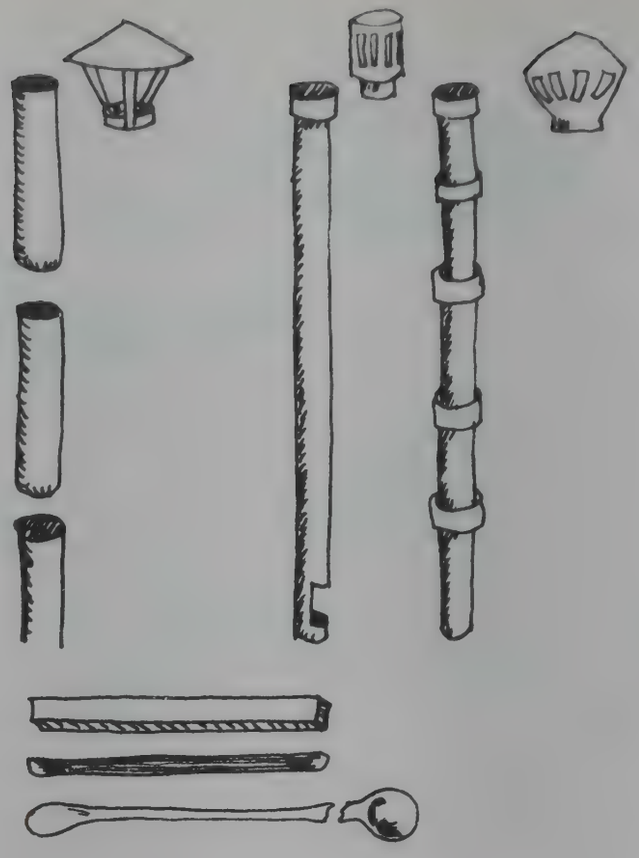
A cowl which can be removed is needed to cover the chimney. The cowl stops rain from coming in but lets smoke go out. The chimney and cowl can be made of different materials depending on what is easily available and local requirements.

—In hilly areas, both chimney and cowl should be made of metal sheet. These are light and easy to carry to remote villages. They also warm the room by radiating heat. 4" (100 mm) diameter and 3 feet (900 mm) long chimney pieces can be made from 5 kilogram rectangular ghee tins. 3 or 4 such pieces can be fitted into each other to get a chimney for a normal kitchen.

—In the plains where it is not necessary to heat rooms most of the year, metal chimneys will not be popular. Where there are local potters, they can make 1 or 2 feet (300-600 mm) long pieces of pottery chimneys. Where there are no potters, 3" or 4" (75-100 mm) diameter asbestos cement pipes can be used.

—Where tin, baked clay or asbestos cement pipes are not easily available, chimneys can also be made with gara. But this needs a lot of labour and time.

5. A 10" to 12" (250-300 mm) long stiff metal strip or one or two pieces of ¼" (6 mm) diameter iron rods are useful for giving more strength to the firebox roof. Any used or waste piece of metal can be used. These can usually be found in most houses.



2. MAKING GARA AND CHAAPRIS

2.1. Making the gara:

For making good gara:

—The best available clay should be used.

—All pebbles and roots should be removed from it.

—All lumps should be broken.

—The clay should be soaked in water overnight to make all clumps dissolve. This can be done by making a heap of the powdered clay, making a recess in the middle and pouring water in it. Or, the clay can be put inside a bucket, a tasla or a large pot, and water poured on it.

—Paddy/wheat straw or pine needles should be finely chopped and all thick pieces removed.

—First the soaked clay (and dung) should be mixed well.

—Then straw and other materials should be kneaded in.

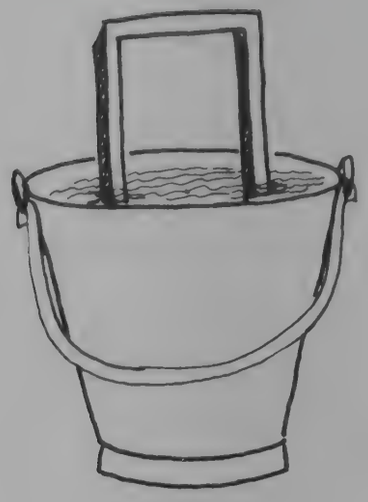
—The gara should not be too thin or too stiff. Very thin gara will not hold shape. If it is too stiff, it will be difficult to mould it to required shapes. A little practice will give a good idea of the best consistency.

Kneading the gara well will increase life, strength and finish of the chulha.

Soaking the clay

2.2. Making the Chaapris:

Normally, chaapris should be made by chulha owners. Mistris can leave chaapri moulds in villages after showing women how chaapris are made. The chulha construction day should be fixed with the owners who should keep the chaapris ready.

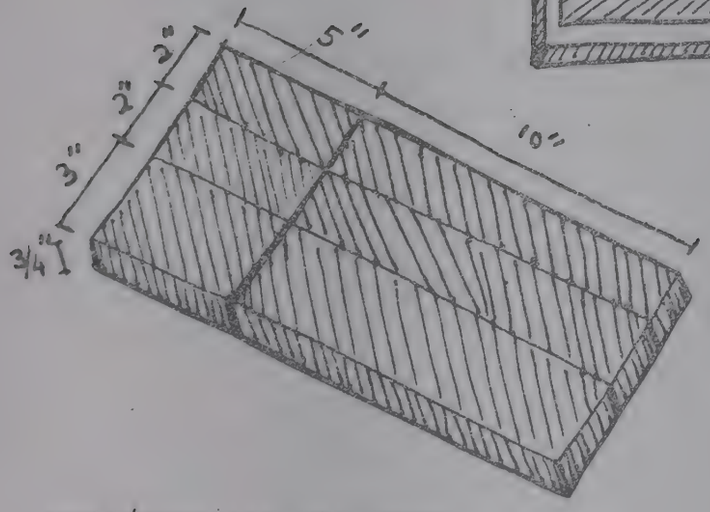


—A flat surface which gets sunlight should be chosen. This could be a roof, the floor of a courtyard or any other place where wet chaapris will not be damaged by animals or children.

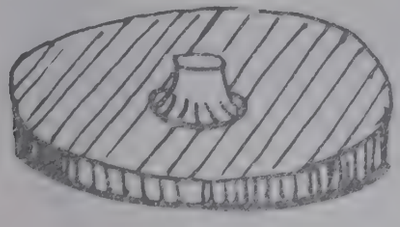
—Some sand or straw should be sprinkled on the ground. Chaapris will not stick to it because of that. Water should **never** be sprinkled on an earthen surface for making chaapris. That will make the earth stick to the gara.

—The chaapri mould should first be dipped in water so that gara does not stick to it.

Then the space within the mould should be filled with gara. This should be pressed into corners and along edges with fingers so that



wet chaapri cut into pieces



Covers for cooking holes.

no space is left hollow.

—Then the surface should be made smooth by moving a wet hand over it.

—While pressing the gara down with one hand, the frame should be lifted carefully.

One chaapri should be cut into smaller pieces while still wet (see sketch). The pieces can be used for roofing the tunnel.

—While making chaapris, covers for cooking holes can also be made. Handles for lifting the covers can be made by shaping gara itself. Or, a bent piece of wire or metal strip should be pressed into the gara.

During summer, chaapris will dry in a day or two. During winter or in colder areas, it will take longer.

—If not to be used soon, dry chaapris should be lifted carefully and stored in a covered place so that they do not get damaged by rain.

SECTION II

3. PLANING THE CHULHA

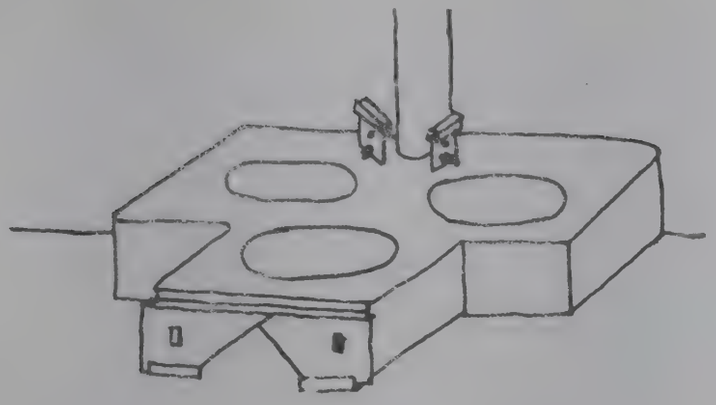
This section tells how the size, shape and place of each chulha should be decided by chulha mistris. Trainers can introduce it in one session divided into three parts: i) how users' needs should be found out, ii) how the chulha's place in the kitchen should be chosen and iii) the general principles for planning the chaapri layout. The three parts should be seen as three steps which trainees should follow while planning a chulha. A blackboard and chalk should be arranged. The introduction can be followed by a role play. One experienced chulha mistri can be a housewife about to get a chulha built. Another one can be the mistri who is going to build it. By acting their roles the two can show how user's needs and a suitable place for the chulha can be found out. Role plays add some fun and play to the learning.

Planning the layout of chaapris can be taught after this. Groups of four or five trainees should practically do the chaapri layout of the most popular type of chulha in the training area.

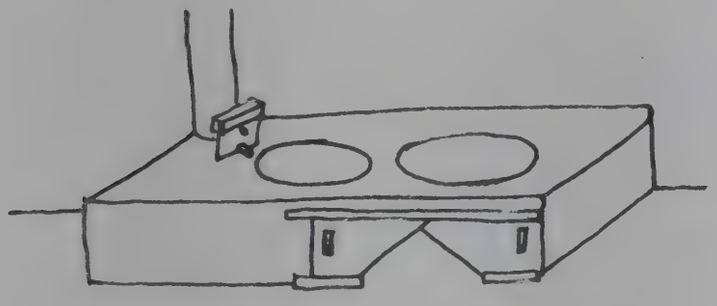
These two sessions will not be enough for teaching the whole chapter. The real learning will start when trainees build chulhas in people's homes. Trainers should supervise practical work carefully. Before each practical work session, what was taught and done on the last day should be revised. Individual trainees should be asked to explain the planning method step by step. Other trainees will step in to point out their mistakes. The trainer should let the trainees do most of the talking during these sessions. At the end the points overlooked or not understood by the trainees can be discussed.

A blackboard which can be placed flat on the floor is very useful during these sessions. The trainees can draw chaapri layouts on this. Village women not used to formal teaching methods find it difficult to draw on a vertical plane. However, they are able to draw quite well if the board is placed flat on the ground.

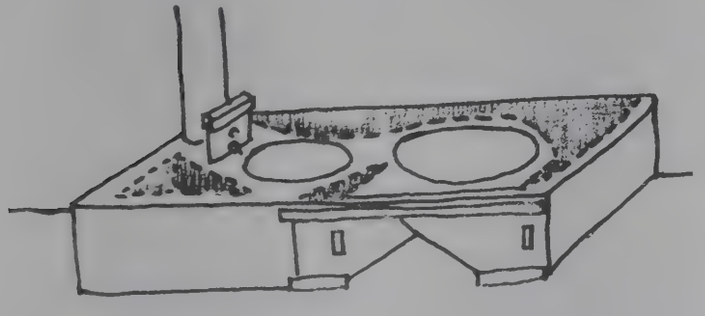
Trainees doing role play at Mada.



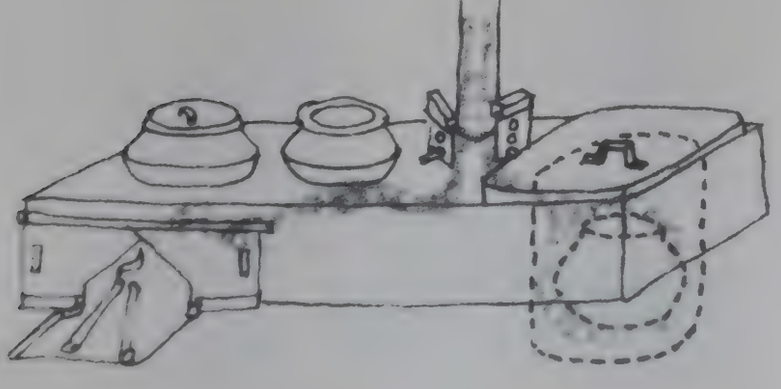
a 3-holed chulha with two tunnels.



a 2-holed chulha.



a 2-holed chulha with hollow construction.



a 2-holed chulha with a hara.

3.1. Finding out the user's needs

Every chulha **must** meet its user's needs. These can be different from region to region and family to family. Large and rich families normally need bigger chulhas with more cooking holes. Large but poor families might need only 2-holed chulhas. In mountain areas, **all** families, small or large, might want a third cooking hole for heating water. Before deciding on a suitable chulha for a family, the housewife should be asked some questions:

1. What needs does her chulha have to meet?

—just cooking meals for the family.

—cooking meals and food for the cattle and thickening milk.

—cooking meals, heating water and heating the room.

2. What are the sizes, shapes and materials of **all** pots in her kitchen?

The mistri should see them all and find out which pots are used the most. The chulha should be built mainly for these. It should also be possible to accommodate the less used pots when needed.

3. What is the daily cooking routine?

—Are food and other items cooked after short times all through the day? For example, as in a large family where many visitors come. A solid chulha should be suitable for them.

—How many items need to be cooked or heated at the same time? The number of cooking holes should be decided on this basis.

—Is food cooked only once or twice a day with long gaps in between? This happens in a small family where all members eat early, go out to work or school, and then eat only the evening meal. For them a small chulha with hollow construction will be better. The heat stored in the chulha body will not be of any use to them.

—If a *hara* is to be connected to the same chulha, the chimney should be on one side with enough space for a hara next to it.

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4. Does the housewife have any strong views about the size, shape, location or the direction in which her chulha faces?

In Nada the women like small rectangular 2-holed chulhas. They feel they look nicer and because their kitchens are small. In Chopal in Himachal Pradesh, large 3-holed chulhas with attached platforms for placing pots are liked better. In some areas, women consider chulhas facing some directions to be bad. Chulhas not respecting such feelings will not be used. It is better to find out about them in advance.

5. What is the most used cooking fuel? Is it fuelwood, dung cakes, agricultural residues or weeds and roots? If fuels other than fuelwood are used, the size of the firebox should be kept a little larger.

6. What is the family's traditional chulha like? The new chulha should not be too much bigger or smaller than this.

—The approximate size of the chulha, number of cooking holes, number of tunnels, and if a *hara* and/or a platform is to be connected to the chulha, should be decided only after finding this information.

3.2. Placing the chulha in the kitchen

Finding the best place for the chulha in the kitchen is also very important. Before choosing a place, the mistri should make sure:

1. That the cook's sitting position will be convenient for cooking. Some women cook sitting in front of the chulha. Others do so by sitting on a side. It is important to check which hand is used for stirring and roasting rotis and make sure that the cooking position will be suitable for using it.

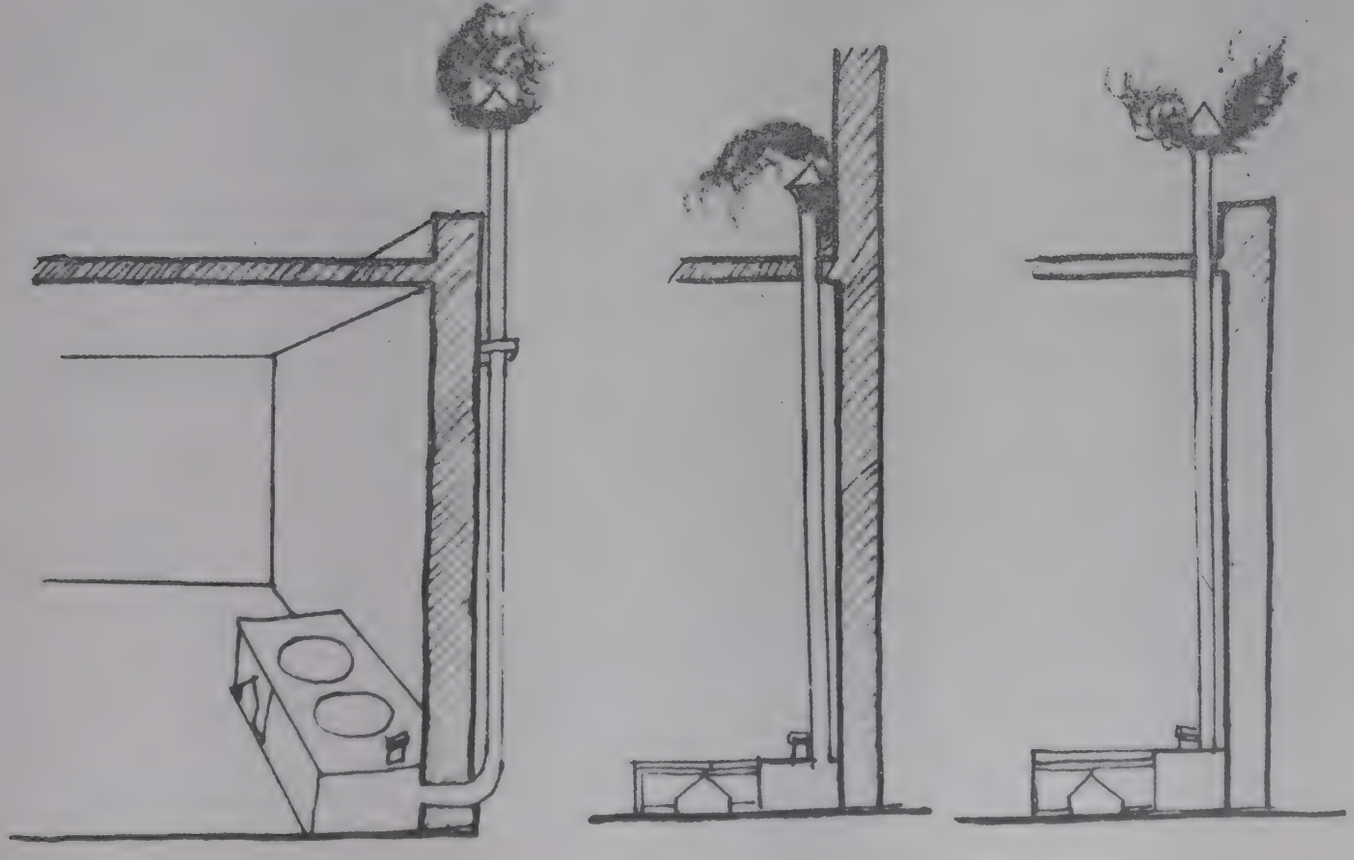
2. That the cook will be able to reach all pots and chimney damper easily while cooking.

3. That there will be enough space in front of the chulha for using long firewood when necessary.

4. That in winter, even other family members will be able to sit around the chulha. As a rule, the firebox should **not** be next to a wall for this.

5. That it will be possible to fit the chimney by making a hole in the roof. This can also be done by standing the chimney outside and connecting it to the chulha through a hole in the wall. Sometimes a beam or other obstruction in the roof makes a place unsuitable for a chulha.

6. That the chimney will not come out of the roof next to a rain water outlet, electricity wires or a high wall which may make smoke come back.

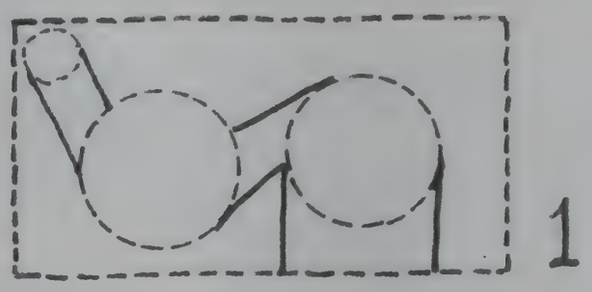


3.3. Planning the chaapri layout.

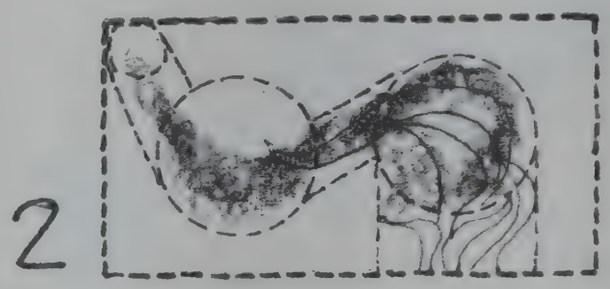
How to plan chaapri layouts for different chulhas is given in chapter V. This part deals with the general principles which should be followed in all cases. Once the trainees have understood these, they will find it quite easy to make changes according to need. Here, the principles are given in a simple way only telling what should be done. Why it should be done this way is explained in chapter III. That should be ready carefully by trainers to explain to trainees.

During chulha construction, the trainers should make sure that trainees do not start chaapri layouts without first finding out users' needs and choosing a good place for the chulha. They should also make sure that chaapri planning is based on the most used utensils. If trainees learn to work this way, there will be very few complaints from users.

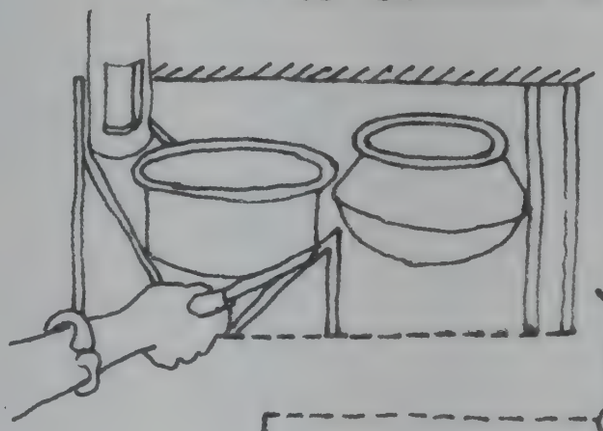
1. Chaapri layout should be started by fixing the places of the firebox and chimney. One or two tunnels connecting the two have to be provided.



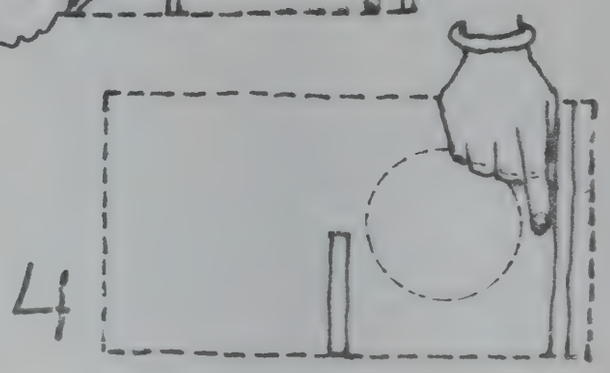
2. It is better if the tunnel bends under each cooking hole. Bends increase the flow resistance and the velocity of the gases passing through them. Both lead to more heat going to pot bottoms. Very sharp bends should not be made.

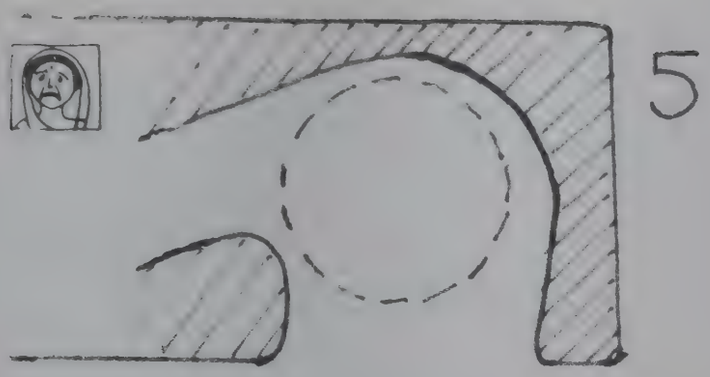


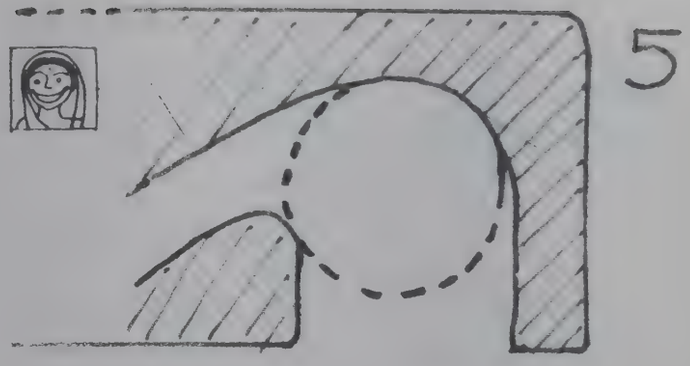
3. Overall chulha size and the position of, and distance between, cooking holes **must** be based on the most used pots. These should be placed in position while marking chaapri layout as explained in Chapter V.



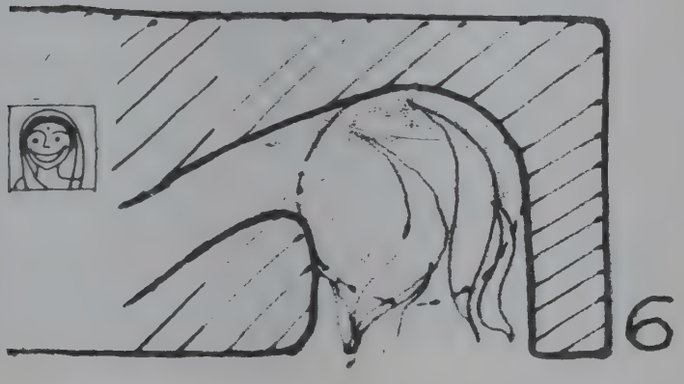
4. Chaapris on both sides of the firebox should be parallel to each other. The distance between them should be 1" to 1½" (25-38mm) more than the diameter of the cooking hole to come above. This will leave space for at least ½" (13mm) thick gara to be applied on both chaapris.

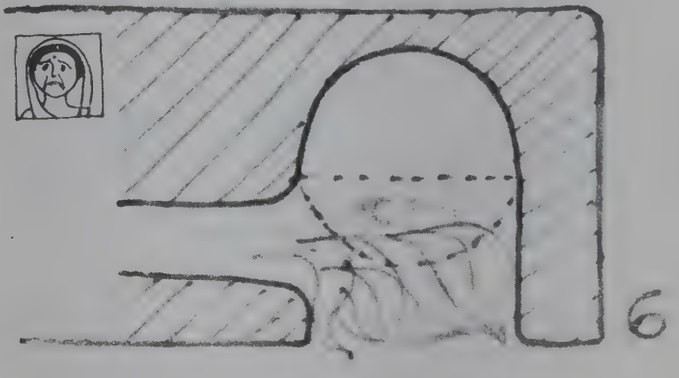




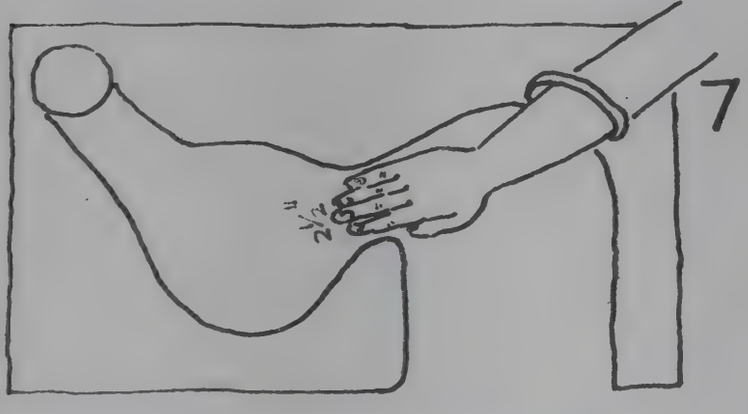


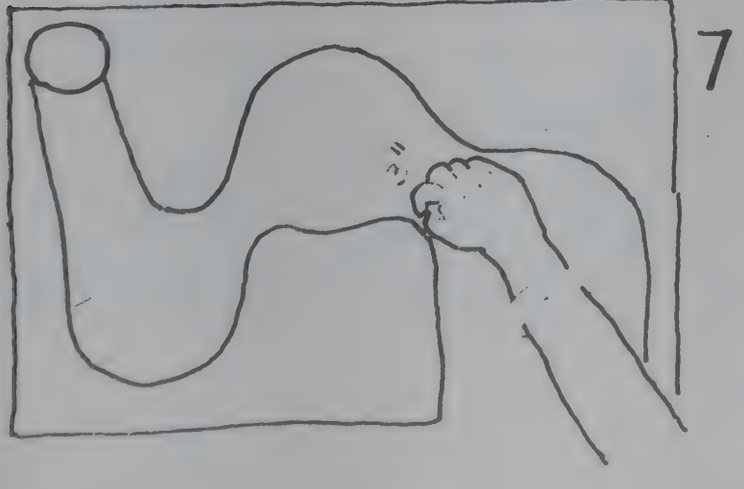
5. The finished width and depth of the firebox should **never** be more than the diameter of the hole above it.



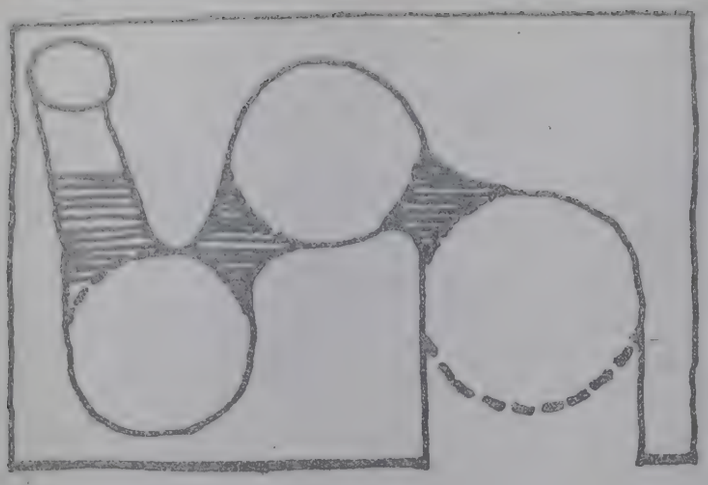


6. The tunnel from the firebox should start from the back of the firebox. This will make sure that hot gases and flames go past more area of the pot bottom before leaving the firebox.





7. For a small 2-holed chulha, the finished diameter of the tunnel mouth can be only 2½" (62 mm). For a larger 3-holed chulha, this should be 3 inches (75 mm). Distances between chaapris should be planned according to this. It should be remembered that at least ½" (13 mm) gara has yet to be applied on chaapris on both sides.



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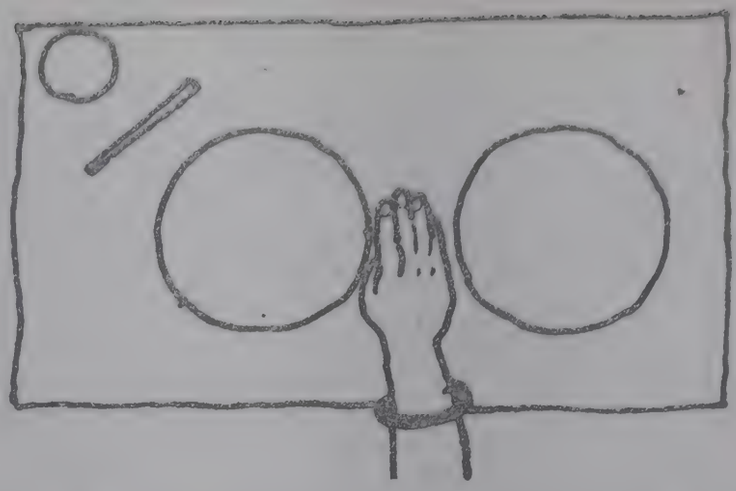

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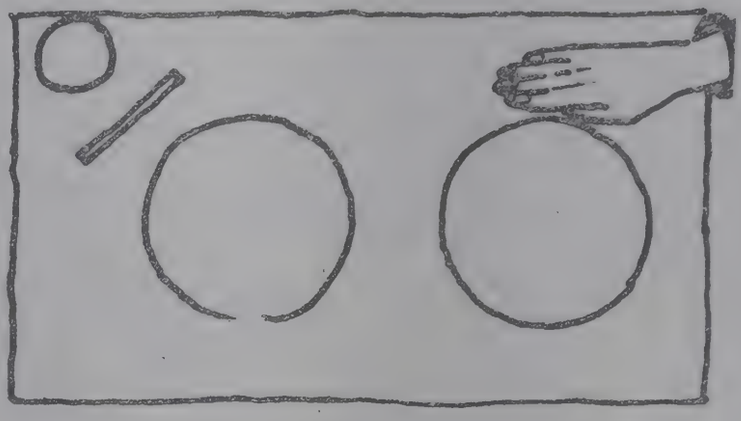
8. The tunnel should be wide where cooking holes are to come and narrow in between. The diameter of cooking holes should be as big as possible for the pots.

9. The distance between cooking holes should be as small as possible. However, it should not be less than 2 inches (50 mm) for enough strength and not so small that two normal pots cannot be used at the same time.



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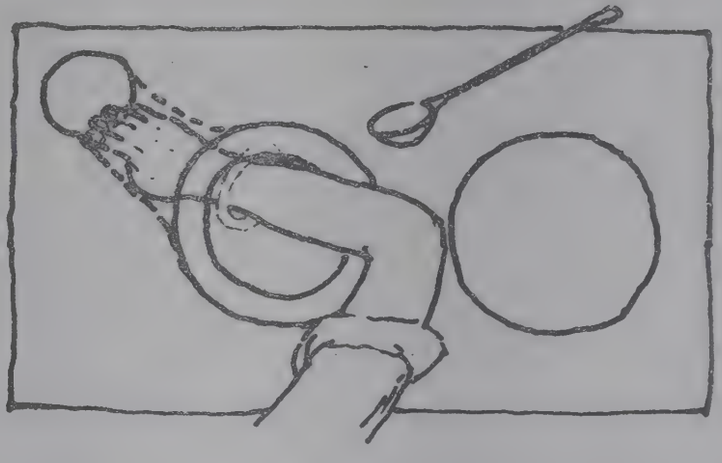
10. All holes should have enough distance from a nearby wall so that pots do not hit the wall.



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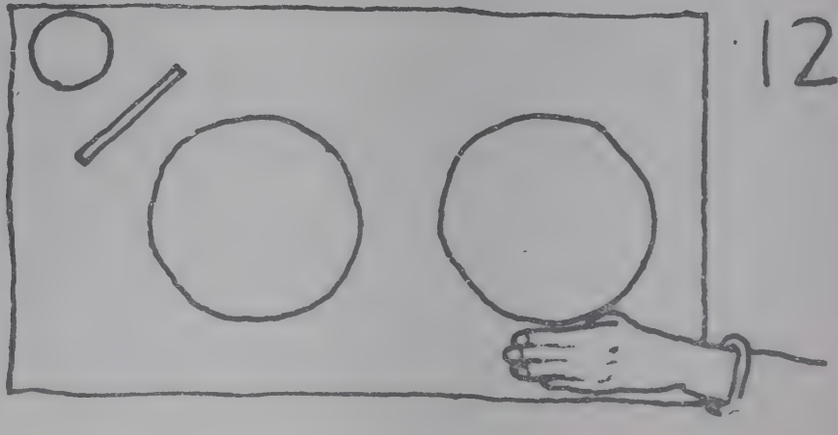
11. The tunnel connecting the last hole to the chimney should be short, straight and wide enough for removing soot from time to time.



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12. The bridge over the firebox mouth should be at least 2 inches (50 mm) but not more than 3 inches (75 mm) wide.

SECTION III

4. BUILDING THE CHULHA STEP BY STEP

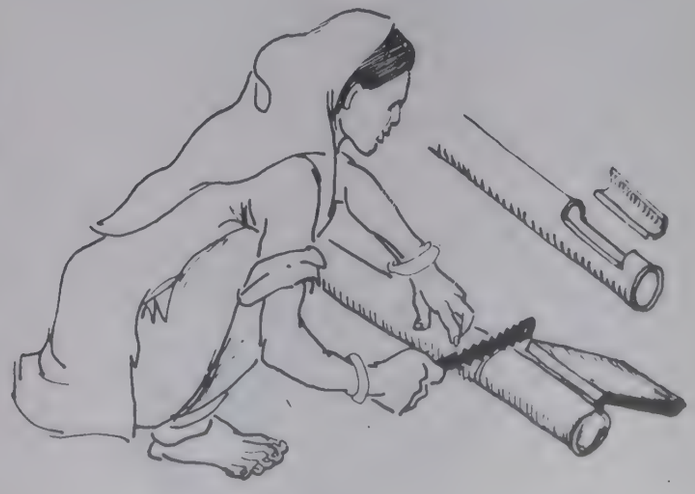
This section gives the step by step method for building the chulha. It also gives the important construction details which must be learnt by trainees. Trainers should introduce this with the help of a blackboard. After this, the trainees should build chulhas. To start with, groups of four trainees can build one chulha, followed by two trainees building one. As they become more confident, each trainee should build two or three chulhas alone.

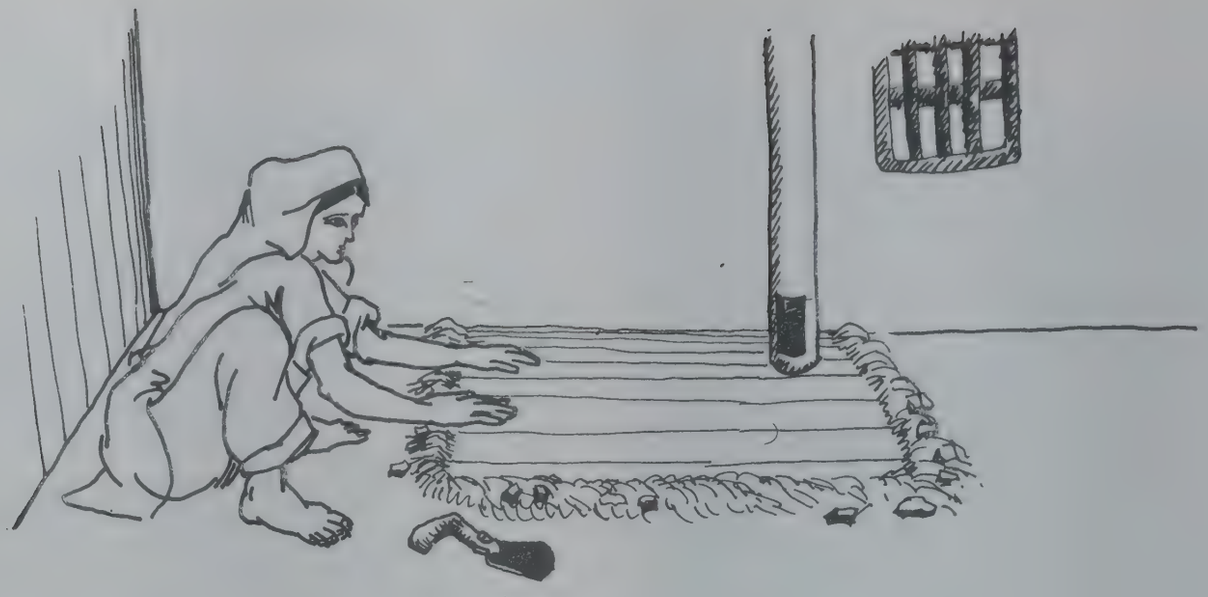
Close supervision during practical work is very important. It should be made sure that the trainees proceed step by step and do not jump steps. Although progress is slow to start with this makes trainees learn the construction method properly.

4.1. Standing the chimney.

First of all, the chimney should be stood in place. Help for making a hole in the roof can be asked from the owner's family.

If an asbestos cement chimney is being used, a hole should be cut in it beforehand. This should be at the point where it will be joined to the chulha tunnel. The sizes and places of holes for different chulhas are given in chapter V. No holes need to be cut in tin chimneys.

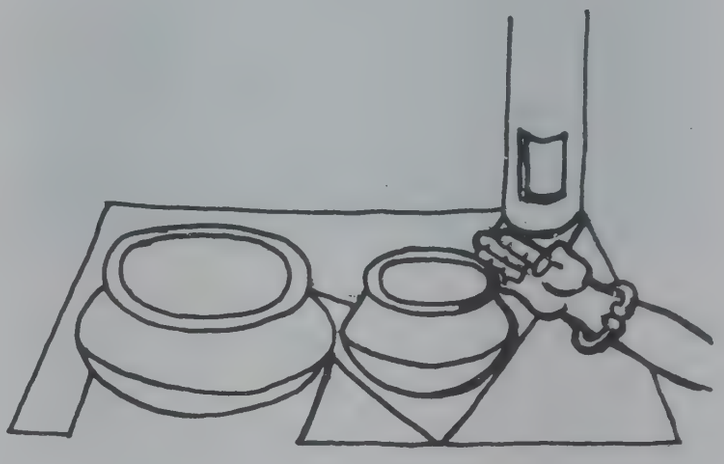




4.2. Levelling/preparing the floor

If the kitchen has an earthen floor, it should be levelled. Sprinkling some water on the levelled area will make it easier to mark the chaapri layout on the ground.

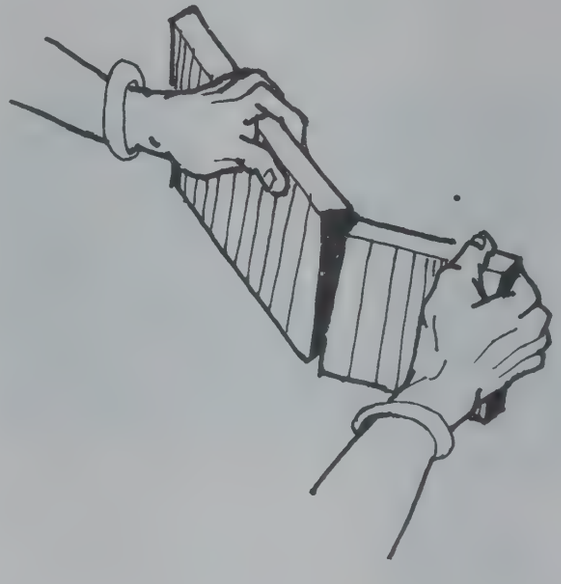
If the chulha has to be built on a wooden floor, **a large stone slab should be placed beneath the chulha.** This should be big enough to have even the ashpit on it so that there is no danger of the floor catching fire. A one inch (25 mm) thick layer of gara should be spread on this to help fix the chaapris.

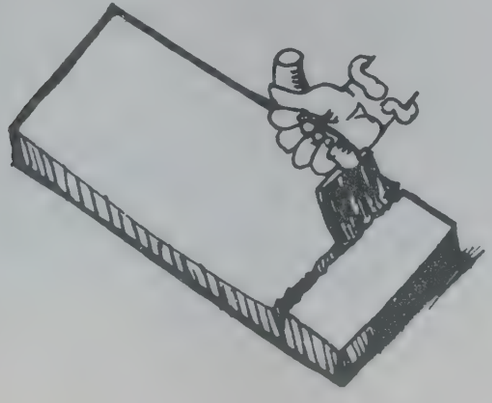


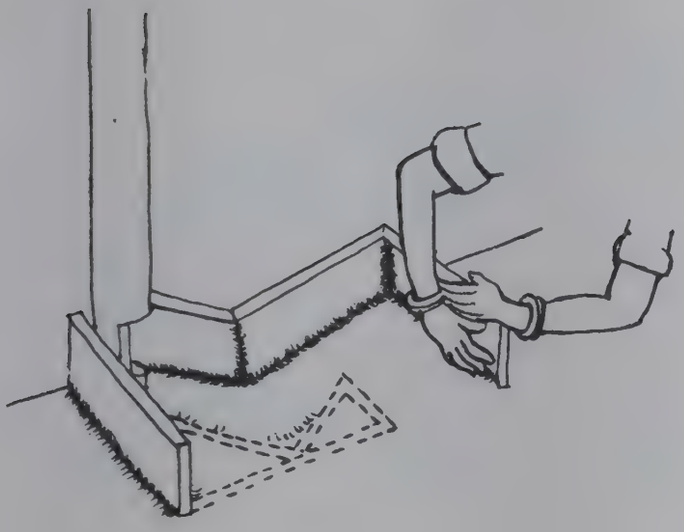
4.3. Fixing the Chaapris

—First chaapri positions should be marked clearly on the ground with a knife or stick.

—Then chaapris should be cut to required lengths. This can be done by making a deep cut along the cutting line with a khurpi and breaking the chaapri by bending the two parts away from the cut. Trainees should not be allowed to break the chaapris without first making the cut.





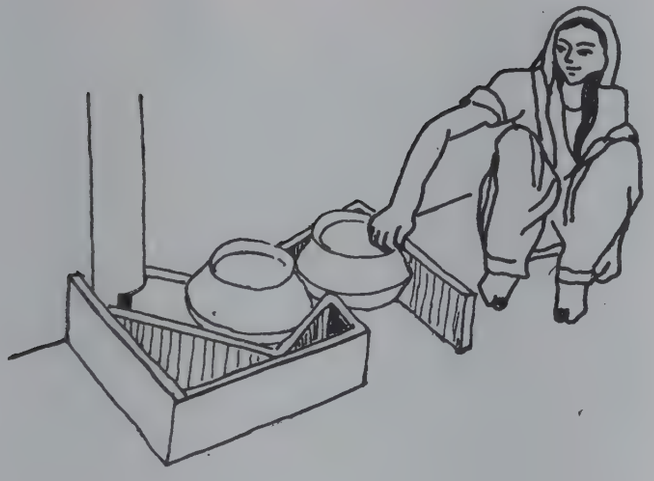


—After digging ½" (13 mm) deep grooves on the floor along chaapri lines and sprinkling some water on them, gara should be applied into them. Chaapris should be placed on this and pressed down.

—More gara should be applied along both lower edges of chaapris to fix them to the ground. If the gara is good and of proper stiffness, the chaapris will stand in position straight away.

—While proceeding, all joints and corners should also be joined with gara.

A little water should always be sprinkled on dry chaapris before applying gara on them. This will give a good bond between the two.



4.4. Rechecking the chaapri layout

When all chaapris have been fixed, the chaapri layout should be rechecked by placing the 2 or 3 pots in position. Trainees should be asked to show their chulhas to instructors at this stage to see if:

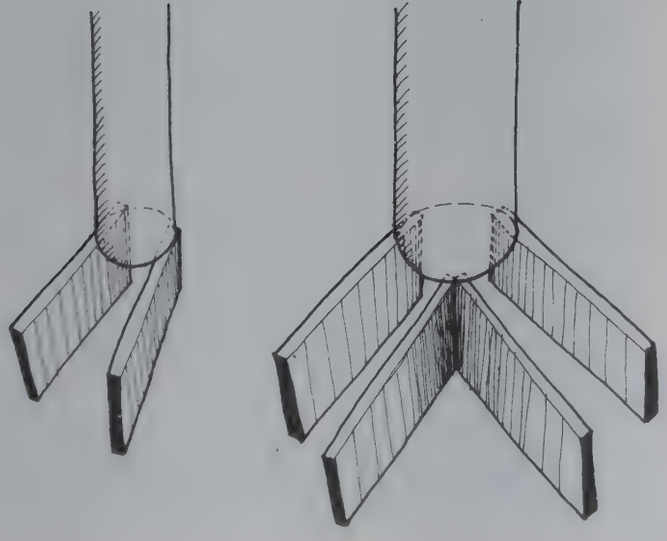
—distance between the pots is correct,

—distance between the last pot and chimney damper is okay,

—the tunnel is shaped correctly and wide enough for the cooking holes under all pots.

—all chaapris are fixed well to the ground and at all joints.

If the position of any of the chaapris is not correct, it can still be changed easily.



4.5. Fixing tin chimneys.

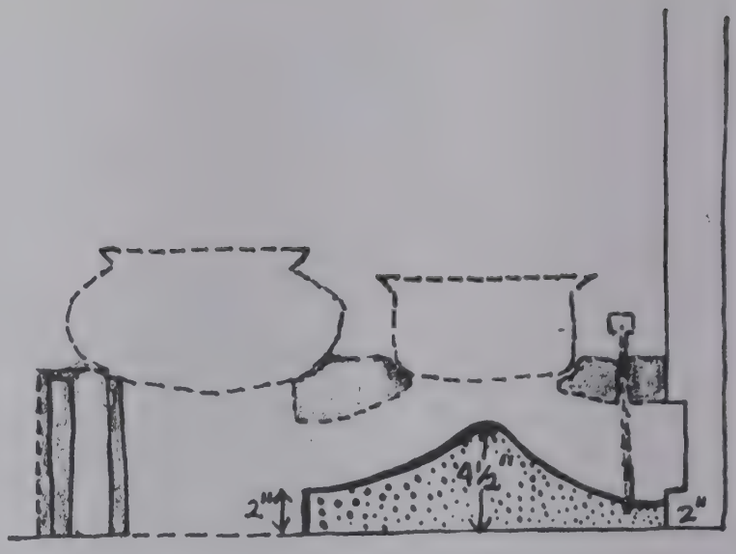
If a tin chimney is being used, it should be supported on top of the nearest chaapri at this stage and secured in position with some gara.

4.6. Filling dry earth into tunnel.

Now some dry earth should be filled in the tunnel area. This should be sloped upwards from the firebox end to rise under the middle of each cooking hole except the one over the firebox. These humps will provide the bases for the baffles.

The depth of the dry earth should be about 2" (50 mm) at the tunnel mouth and the chimney end. It should be about 4½" (112 mm) under the holes.

Some water should be sprinkled on the dry earth.



4.7. The first stage of gara application.

—The purpose of this stage is to shape the walls and floor of the tunnel and firebox before they are 'roofed' over. It is difficult to do this once the top has been covered.

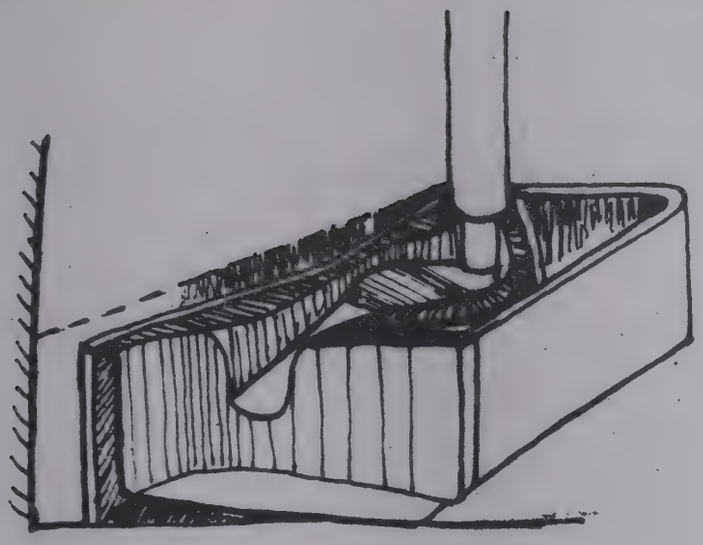
—After sprinkling water on the internal faces of tunnel and firebox walls, gara should be applied firmly on all of them. All angles should be rounded off.

—Similarly, gara should be applied on the firebox floor and on the dry earth filled in the tunnel. Before moving to the next step, it should be checked:

1. that the clear width and depth of the firebox are roughly equal to the diameter of the cooking hole to come above.

2. that the tunnel is of the right width below cooking holes and less wide in between.

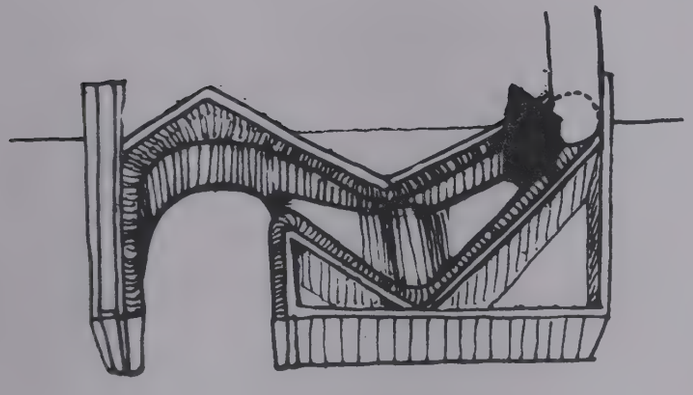
3. that at the chimney end, the tunnel is of the correct width for fitting the chimney damper. This can be checked by sliding the chimney damper in position after dipping it in water. It should cut into the gara about ¼" (6 mm) on both sides.



4. that if the chimney is of asbestos cement, gara on the tunnel floor finishes level with the lower edge of the hole cut in it. If the chimney is of tin about 2" (50 mm) gara should have been applied on the floor under the chimney.

5. that the baffle across the tunnel under the second or third cooking holes is roughly of the correct height.

6. that the firebox floor is raised about 1" (25 mm) on the back side.



7. that the mouth of the tunnel starts about 3" (75 mm) above the firebox floor, and,

8. that all chaapri faces inside the tunnel and its floor have been covered with gara.

4.8. Rechecking the distance between pots.

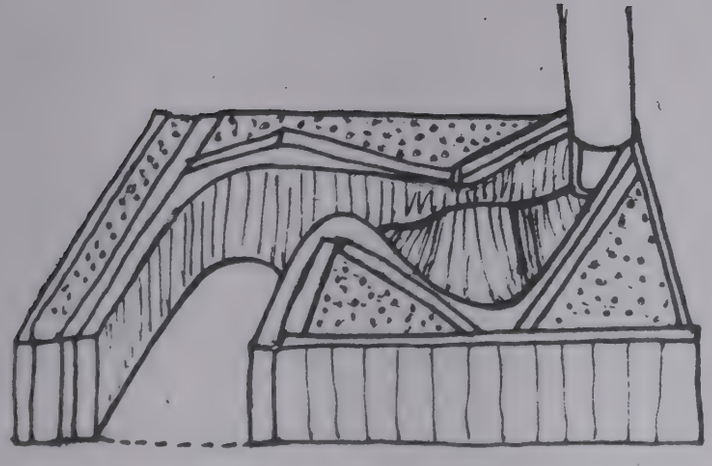
The chulha is now ready for 'roofing'. Before starting that, distances between cooking holes should be checked again by placing pots in position. If the distance between the pots or between the chimney damper and the last pot seems too little or too much, the necessary changes should be made before moving to the next step.

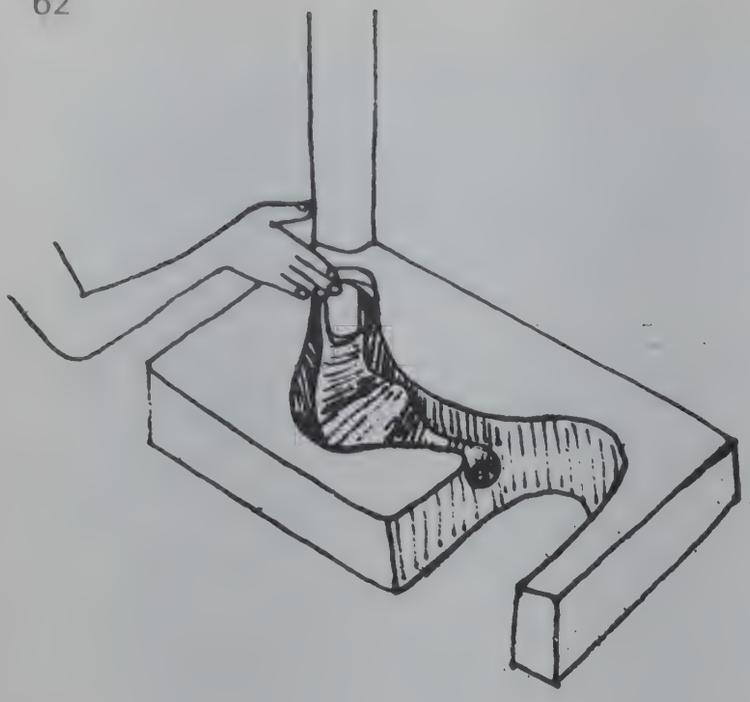
4.9. Filling the hollow spaces.

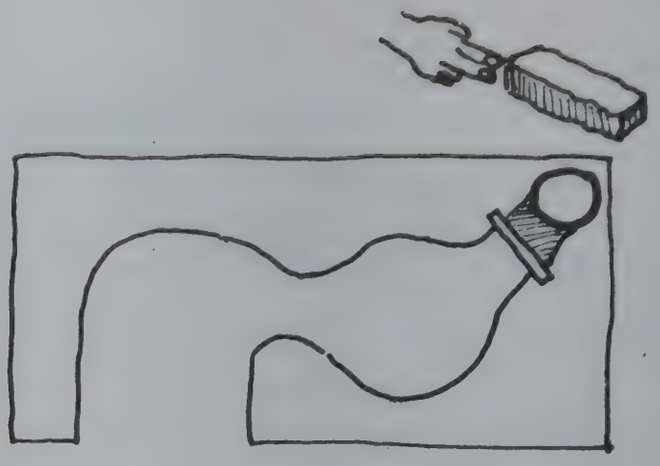
Next all hollow spaces between chaapris (other than the firebox and the tunnel) should be filled with dry earth. After making this level, a little water should be sprinkled on it.

—Trainees must be discouraged from filling in dry earth before gara has been applied inside the tunnel. The weight of the earth can push the chaapris in different directions and spoil the chulha structure.

—If these spaces are to be kept hollow they should be closed from above with chaapri pieces. Where hollow spaces are quite wide, more chaapri pieces should be stood inside them to support the covering pieces.







4.10. Roofing the tunnel

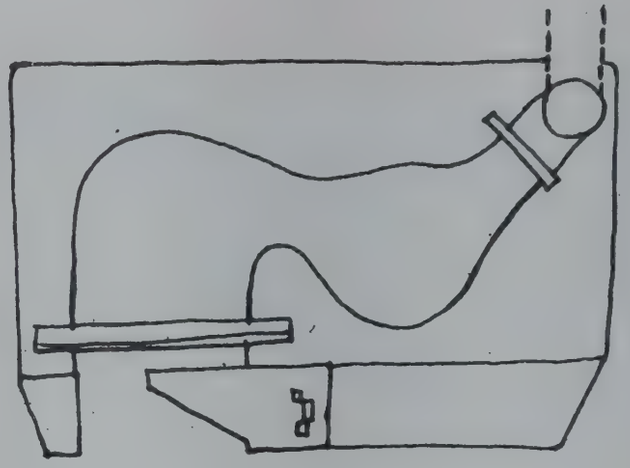
—This should be started from the chimney end. A 1½" (37 mm) thick and 2" (50 mm) wide stiff slab of gara should be made. It's length should be more than the tunnel width.

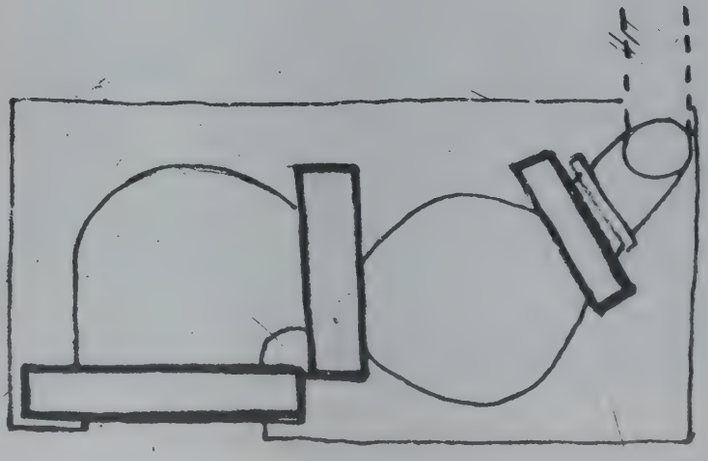
—This should be stuck firmly to the chimney and across the tunnel. After dipping the chimney damper in water, it should be slid in position. The gap between the damper and the chimney should be completely closed.

—An iron rod or stiff metal strip should then be placed across the firebox mouth. The height of the firebox mouth should be checked by placing the front dampers in position. The metal support should be at the same level as the top edge of the dampers.

—Next, three pieces from the chaapri cut while still wet should be used for roofing the tunnel. One short piece should be placed across the tunnel between the chimney damper and second cooking hole. Another one should come between the two cooking holes. A longer piece should be placed above the metal support across the firebox mouth. This should be placed a little away from the chulha face so that the damper guide does not hit it when that is fixed.

—The positions of the roofing pieces should be adjusted with the help of pots to make sure that enough width for cooking holes is left in between.





—All roofing pieces should be fixed by applying gara firmly above and under them. The inside corners of the tunnel should be rounded off.

—The tunnel ceiling should be sloped upwards towards each cooking hole to direct more heat and flames to the pots.

—The bridge across the firebox mouth should be finished with more care. This gets the most wear and tear. Gara should be applied firmly into its lower corners and under the bridge and pressed in with fingers. No hollow spaces should be left in the gara.

—The ceiling of the bridge should also be sloped a little upwards towards the cooking hole over the firebox.

4.11. The second stage of gara application

—Now gara should be applied on top of the chulha and on its outer sides and made level. **All** chaapris must be covered with at least ½" (13 mm) of gara. This is to made sure that all the parts are joined together.

—Baffles under cooking holes should be given their final shape. They should form a flat ridge which is about a ½" (13 mm) higher on the shorter side of the path leading to the chimney compared to the other end. The distance between pot bottom and the centre of the baffle should be ¾" (20 mm).

4.12. Shaping the cooking holes

—In homes where pots with rounded bottoms are used, the shaping of cooking holes is best done with the help of these.

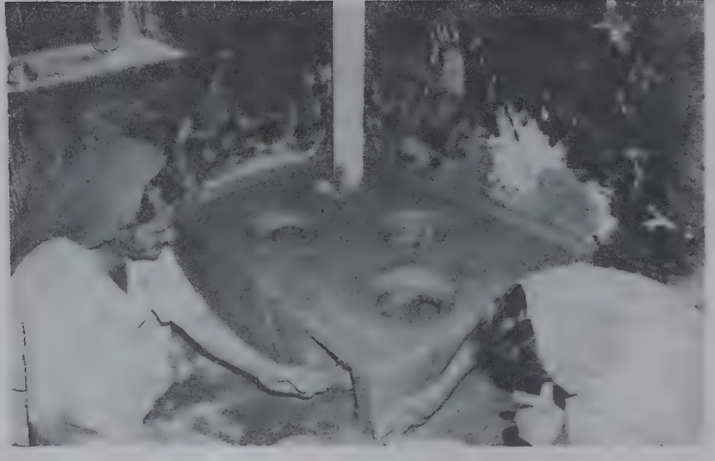
—First roughly circular shapes should be made by hand. This can be done by placing wet pots in position and applying gara all around them. After lifting the pots, a better finish can be given by hand.

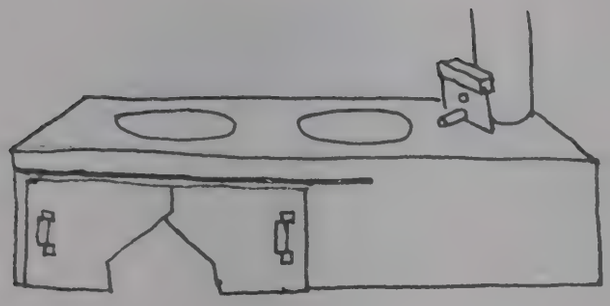
—Then a wet pot should again be placed into each hole and rotated both ways while pressing down firmly. The pot should sit one to two inches (25-50 mm) inside the chulha.

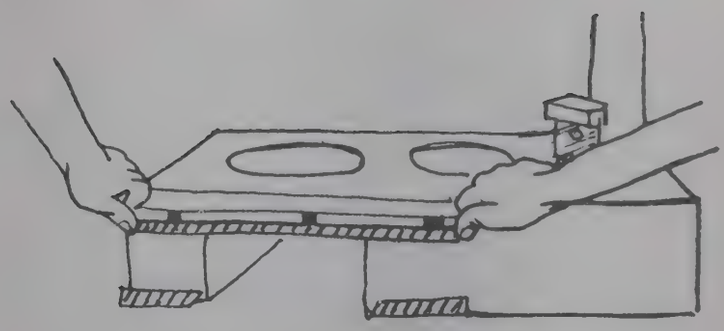
—On removing the pot, the points where the pot has rubbed against the gara will be visible. These are fine. More gara should be applied at other points and the pot rotated inside the hole again. This should be repeated till not only the upper but even the lower edge of the hole is completely circular. The lower edge of the hole can be shaped with a smaller pot with a flat bottom. By rotating it gently in the hole one can get a completely circular marking on the gara.

4.13. Finishing the chulha

Now the top and outer surfaces of the chulha should be finished neatly by gently moving wetted hands on them. The front face of the chulha should be level and straight so that the front dampers can slide against it easily.

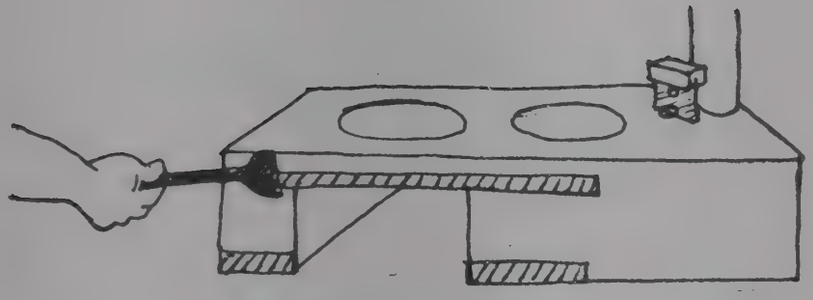




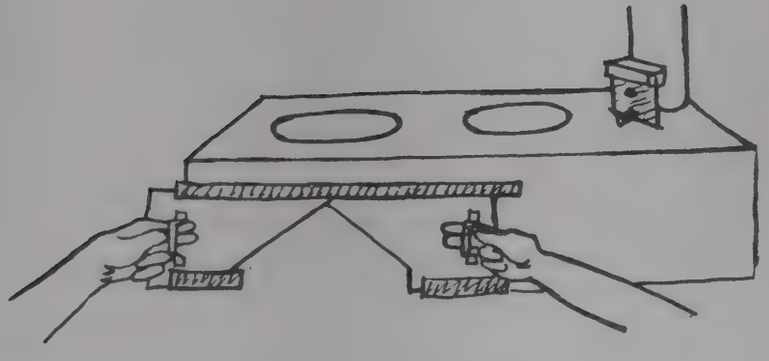


4.14. Fixing the front dampers

—After placing the front dampers in front of the firebox mouth, a line about ⅛" (3 mm) above their top edge should be marked. The upper guide should be pressed into the chulha along this line. It can be hit gently along its length with a hard object till there is a gap of only ⅛" (3 mm) between the guide and chulha face.



—The two lower guides should be pressed in the same way keeping the dampers in position. It should be made sure that these do not project into the firebox or beyond the chulha. If they do so, they can cut hands while ash is being removed or the chulha being cleaned.

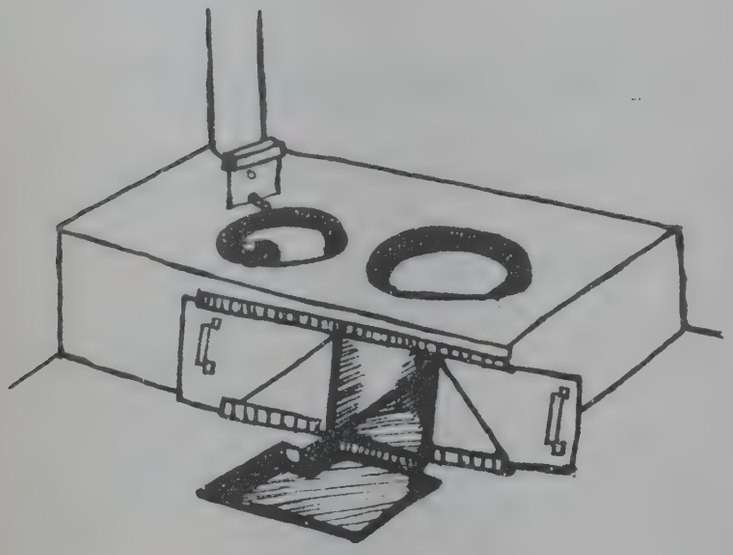


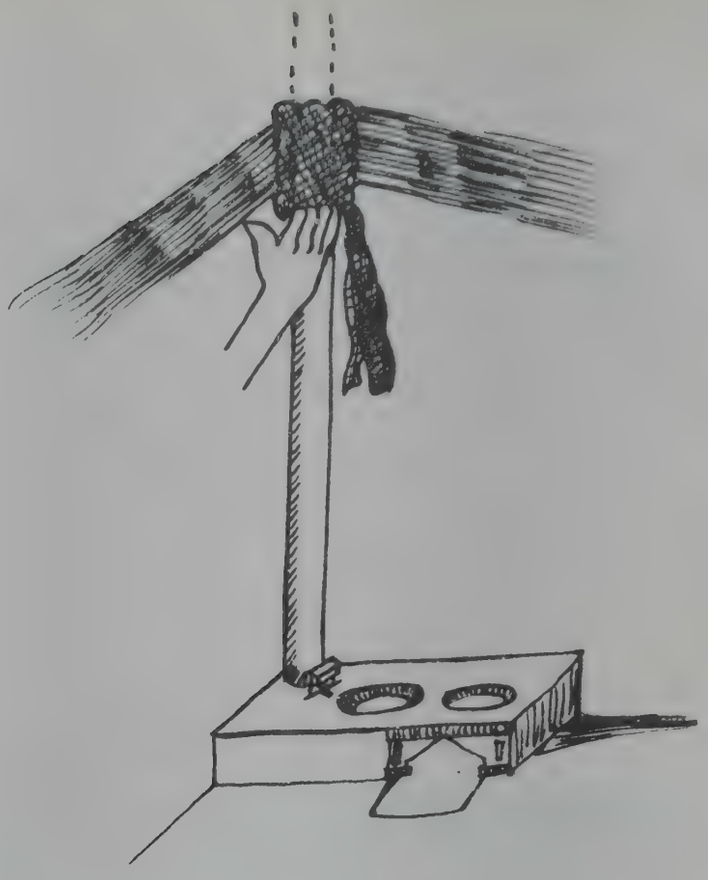
—The dampers should be slid back and forth to make sure that they move freely.

—Gara should be pressed in under the lower guides to fix them properly.

—Similarly, gara should be applied along the top edge of the upper guide to give a neat finish.

—The chulha is ready!





4.15. Making the ashpit

This can normally be left to the chulha owner. The ashpit can be of any shape or size according to the owner's liking.

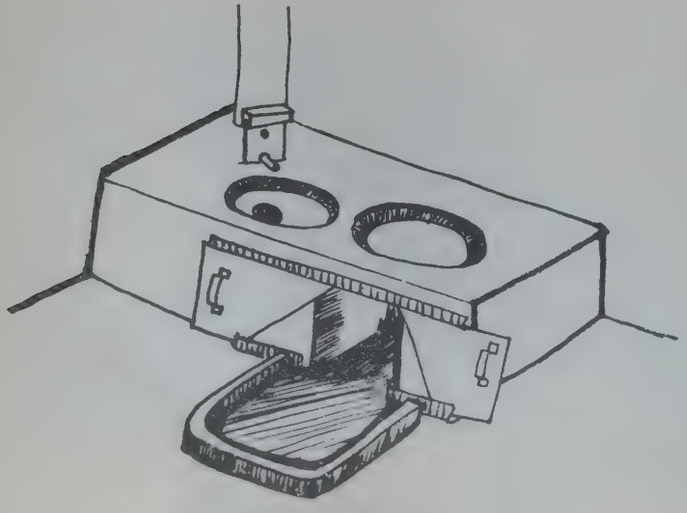
—In some areas it is made by digging the floor in front of the chulha. If this is done, the owner should be made to understand that the digging should **not** be done inside the firebox.

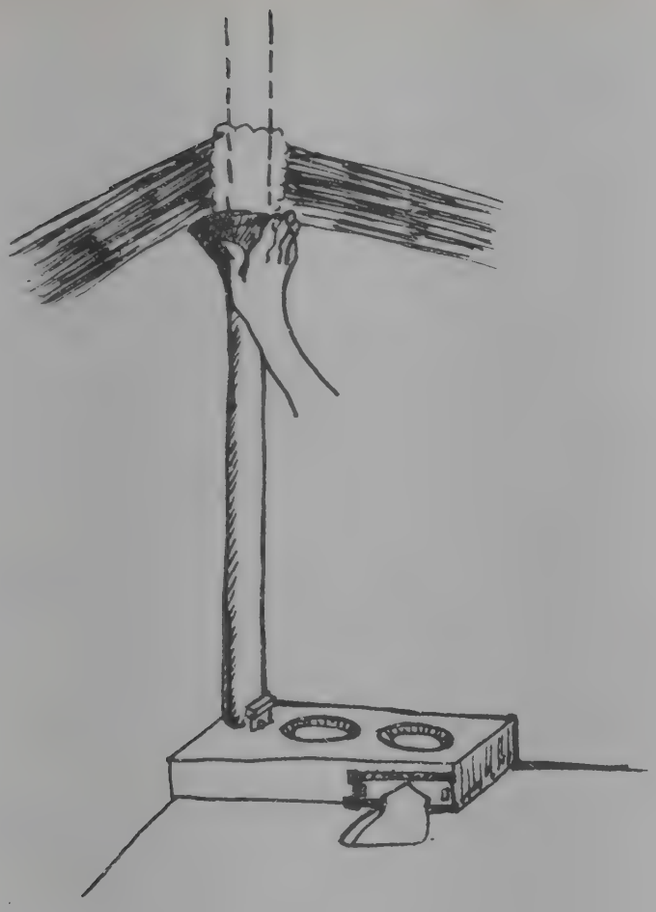
—In some areas, or where the floor is of cement or stone, the ashpit is made by building a ledge with gara.

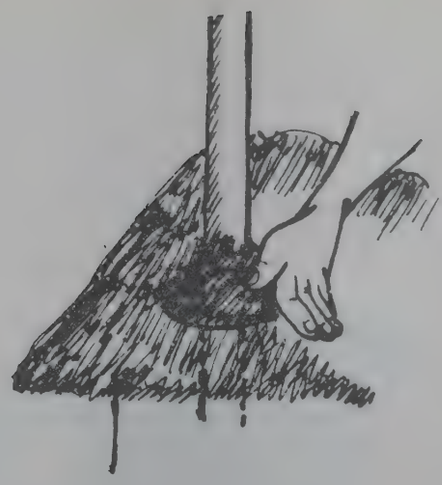
4.16. Closing the gap between the roof and chimney.

This will normally be done by the house owner. However, where the chimney passes through a thatch roof, the chulha mistri should do it herself to make sure that there is no danger of fire.

—First a waste piece of cloth should be stuffed between the chimney and the thatch all round the chimney. This should be done both from inside the room and from the roof outside. The stuffed cloth will stop the joint from leaking.







—Then a thick layer of gara should be stuffed all round between the thatch and chimney. This is to stop a hot chimney from touching the thatch.

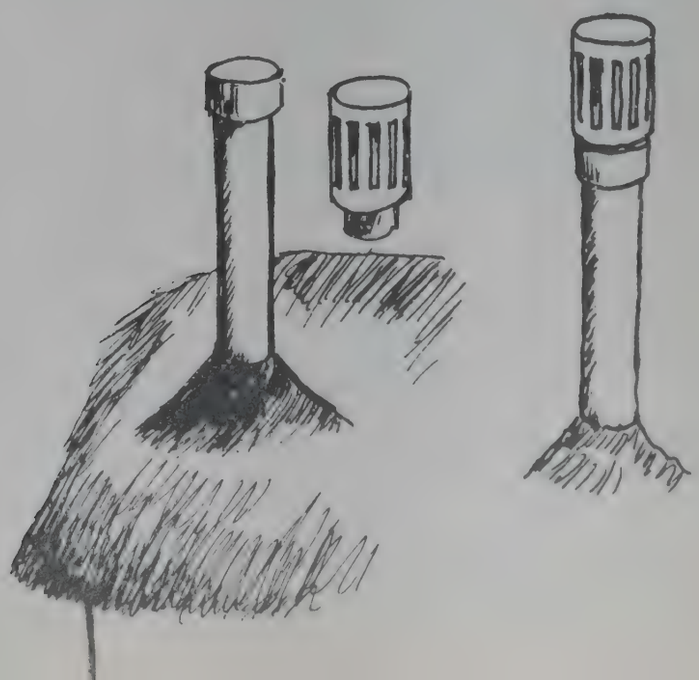
—This should be finished by applying thick gara around the joint of the chimney and roof so that the gara slopes away from the chimney. This will stop any water from standing near the joint.

4.17. Fitting the cowl

—Unless it is raining, this can be done after the chulha has dried completely.

For asbestos cement chimneys with collars, a bottle cowl which just sits inside the collar can be used. For a 3" (75 mm) diameter chimney, a 4" (100 mm) diameter cowl should be used.

—A tin cowl can also be fitted inside the collar. If there is no collar or the chimney is of tin, only a tin cowl should be used. It can be fitted around the chimney.



SECTION IV

5. CHECK LIST AFTER FINISHING THE CHULHA

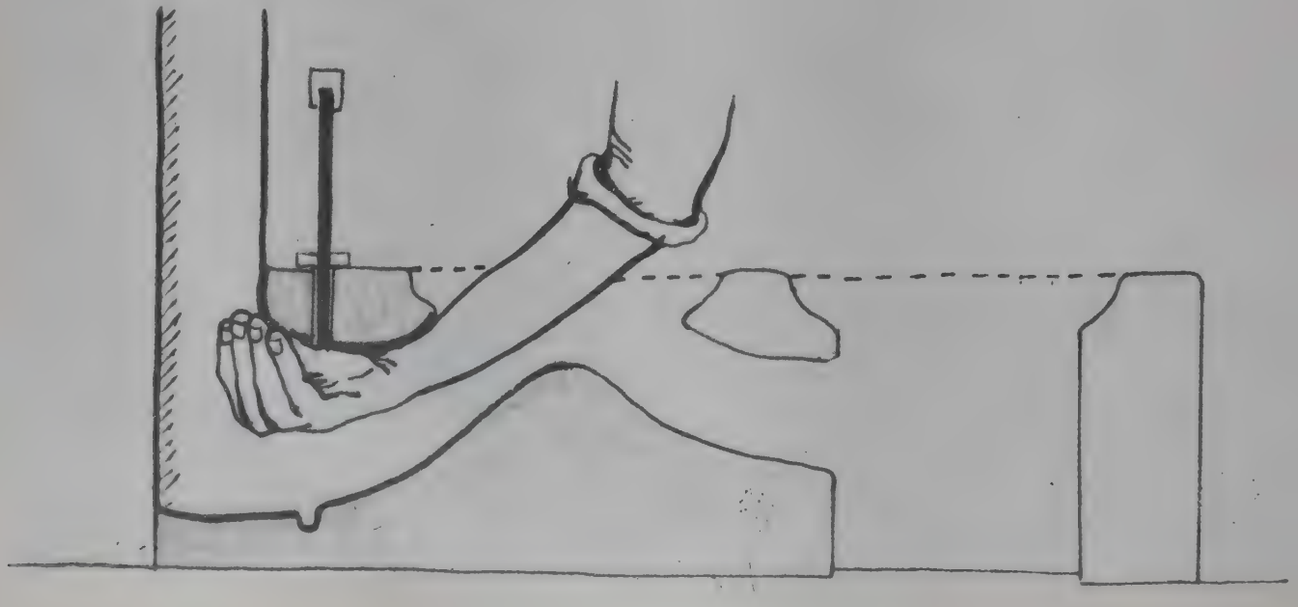
This section is specially meant to help trainees and chulha mistris get the habit of checking important construction details before leaving a newly built chulha. If they get this habit, the chulhas built by them will work well and will need few changes later on.

Most of the points in the check list have already been covered in section III. But it is useful to pull them out for special attention. Their selection is based on the common construction mistakes made by trainees and mistris.

Trainers can use this section to check the chulhas built by trainees point by point and repeat the drill a number of times. Common mistakes of the first day of practical work should be discussed before starting work the next day.

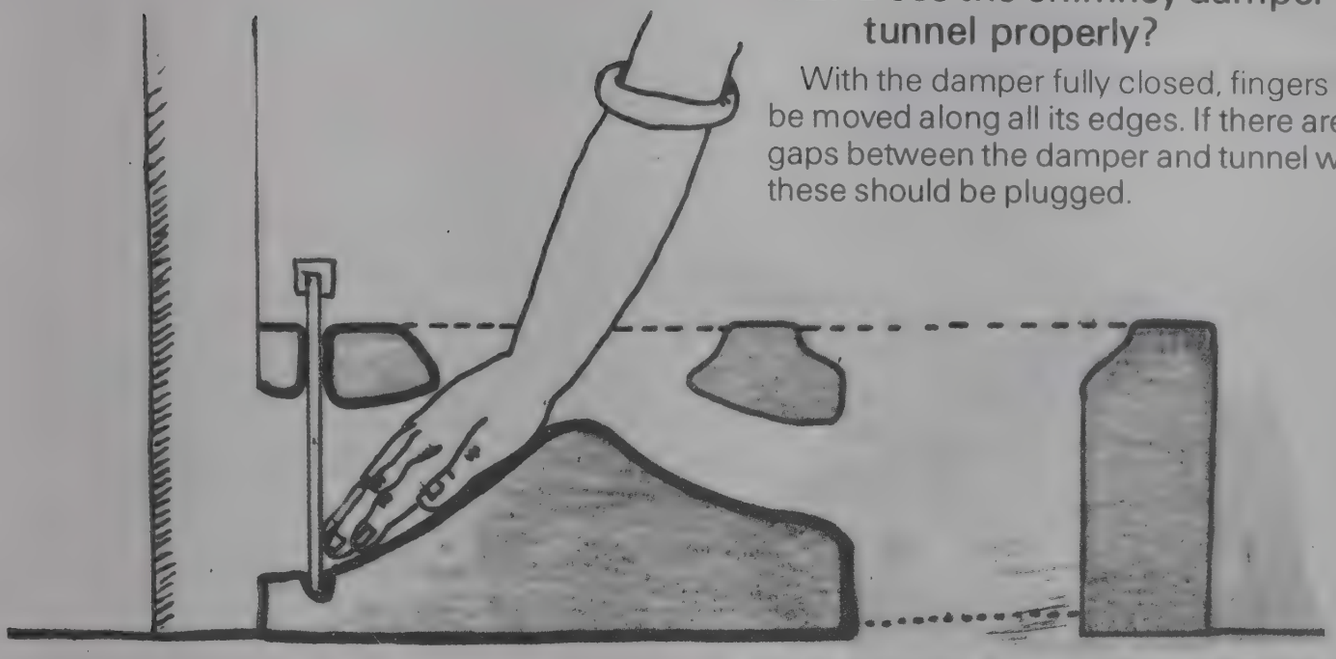
5.1. Is passage to the chimney clear?

This can be checked by lifting the chimney damper carefully and moving a hand up the chimney through the nearest cooking hole. Sometimes, fallen gara or dry earth are left inside blocking the passage to the chimney.



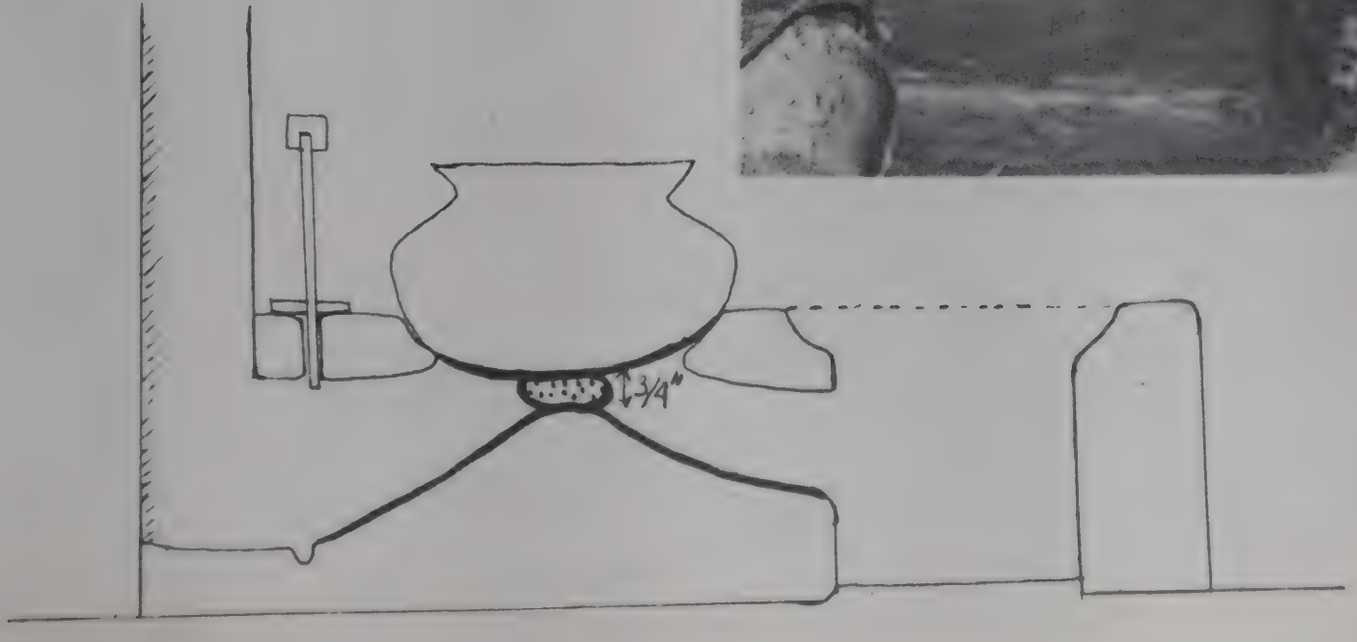
5.2. Does the chimney damper fit the tunnel properly?

With the damper fully closed, fingers should be moved along all its edges. If there are any gaps between the damper and tunnel walls, these should be plugged.



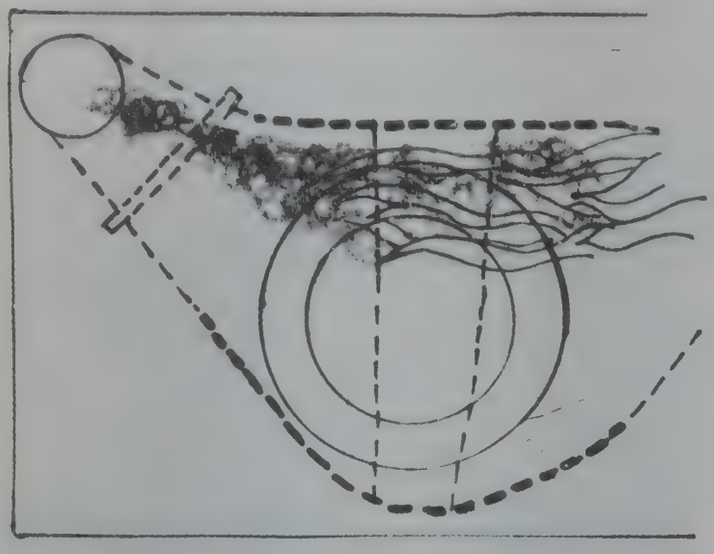
5.3. Are all baffles of correct height and shape?

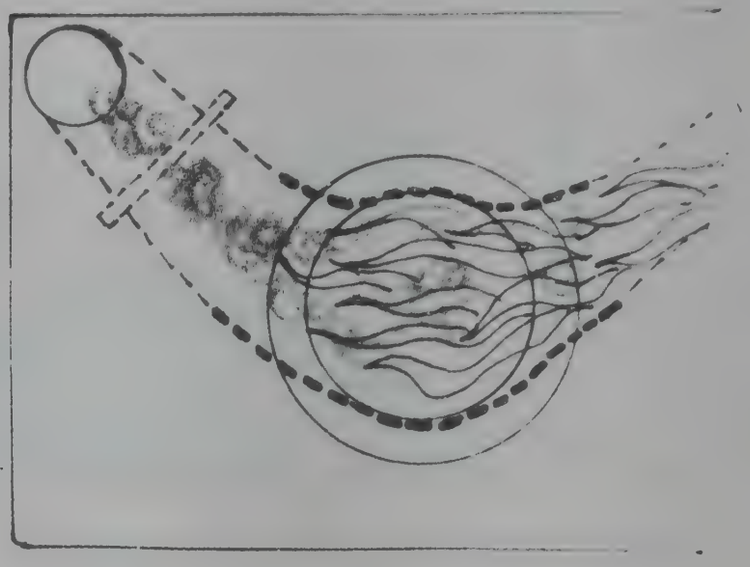
The gap between a baffle and pan bottom can be checked by placing a ball of gara in the centre of the baffle and pressing a pot down in the cooking hole. The squashed thickness of the gara will show the gap size. If it is more or less than ¾" (20 mm), the baffle should be raised or lowered accordingly.



5.4. Is the width of tunnel under cooking holes correct?

The tunnel width under cooking holes should **never** be more than the diameter of the hole above. Otherwise hot gases and flames will pass the pots without giving them much heat.

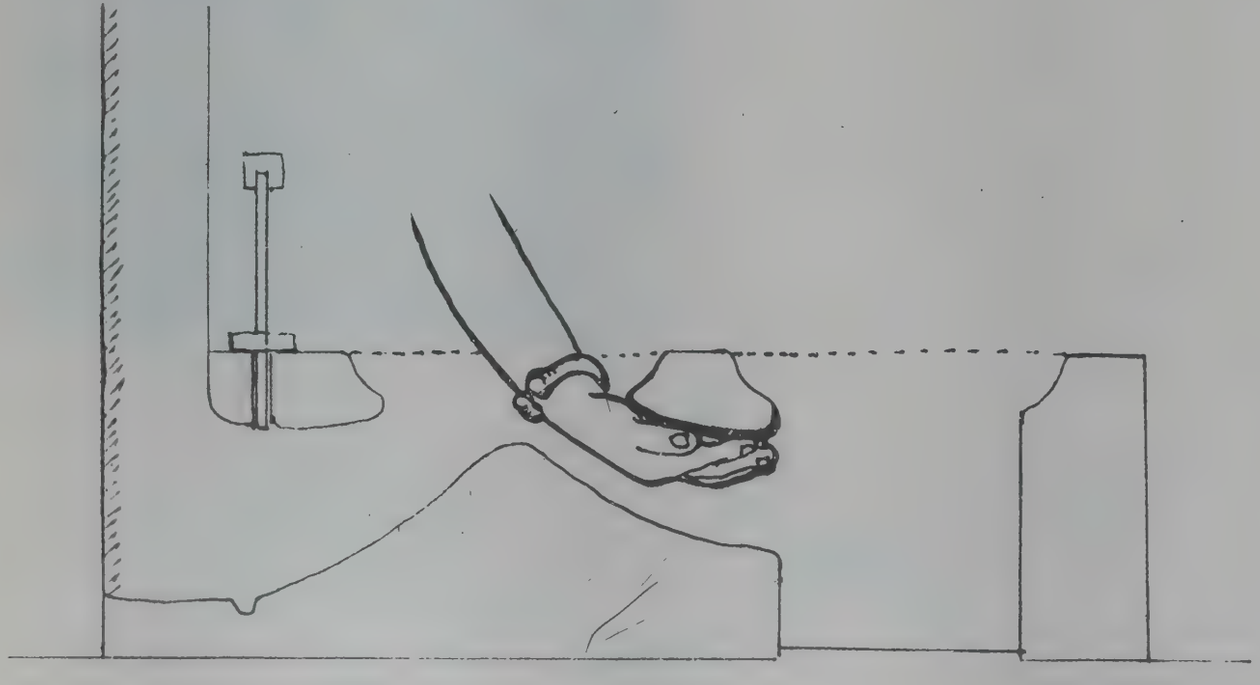




5.5. Is the tunnel ceiling of correct shape and thickness?

This can be checked by feeling the shape of the tunnel ceiling by hand.

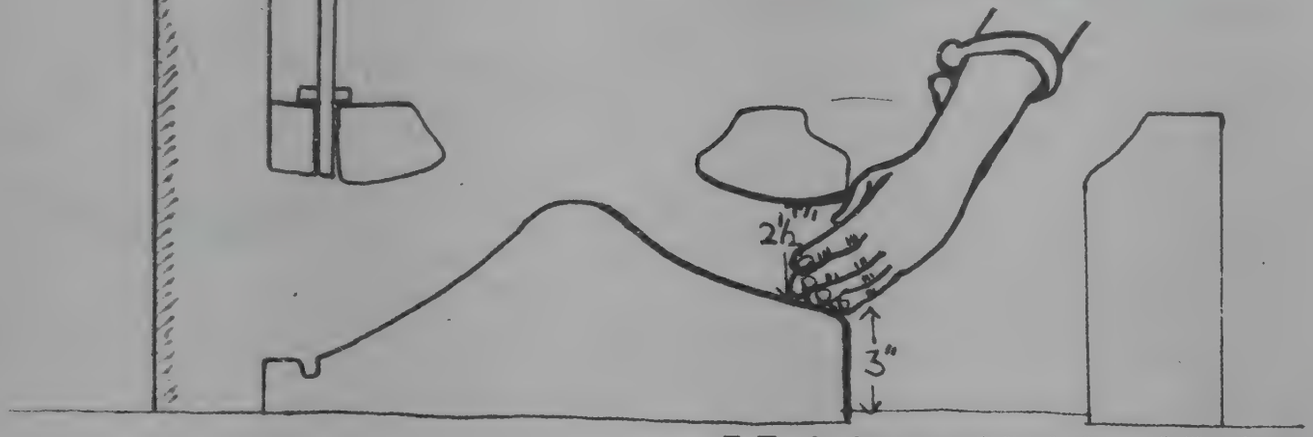
At points where the tunnel opens in to a cooking hole, its ceiling should slope upwards towards the hole. The roof there should be as thin as possible.



5.6. Is mouth of tunnel correct?

—For a small 2-holed chulha this should start about 3" (75 mm) above the firebox floor. Its diameter should be about 2½" (62 mm).

—For larger or 3-holed chulhas, the tunnel diameter should be 3 to 3½" (75-87 mm) (closed fist of a small hand).

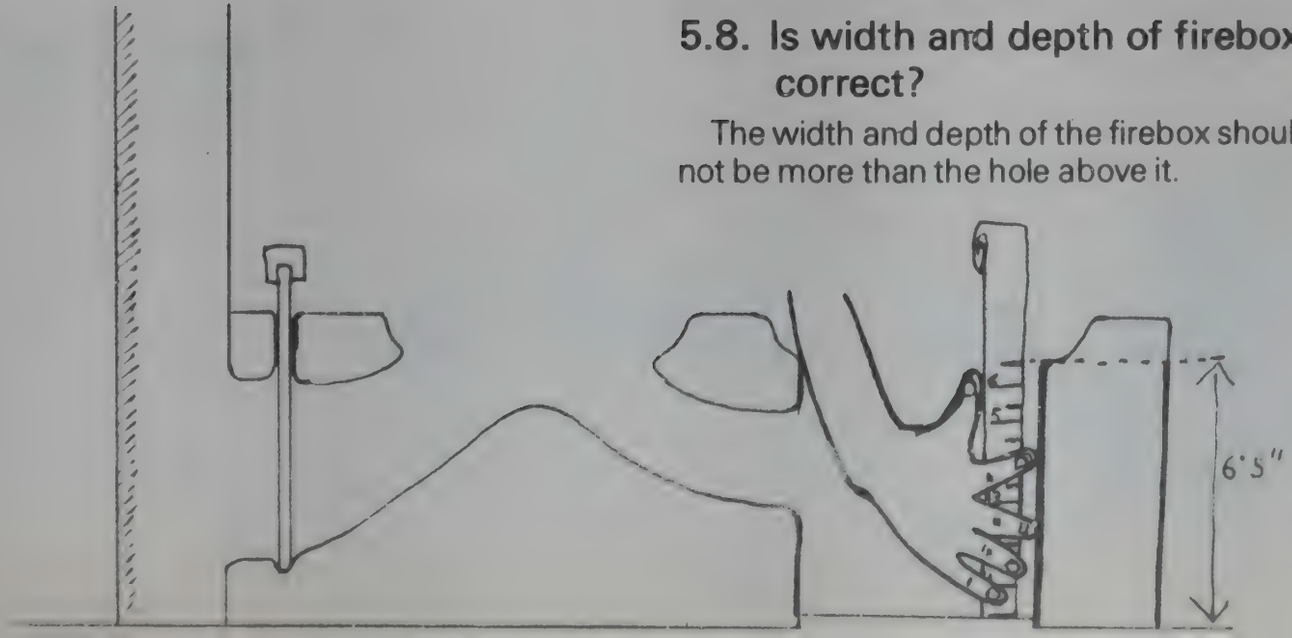


5.7. Is internal height of firebox correct?

In areas where mainly fuelwood is used, this should be about 6.5 inches (162 mm) from the firebox floor to the lower edge of the cooking hole. Where dung cakes, agricultural residues, weeds etc. are the main fuel, this should be kept 7 to 7.5 inches (175-187 mm). These fuels are more bulky. They also produce more ashes which collect quickly inside the firebox making its clear height less. In areas where even traditional chulhas are only 5" to 5.5" (125-137 mm) high, the firebox height can probably be kept the same as people are used to using lower chulhas. But this needs to be tested in the field.

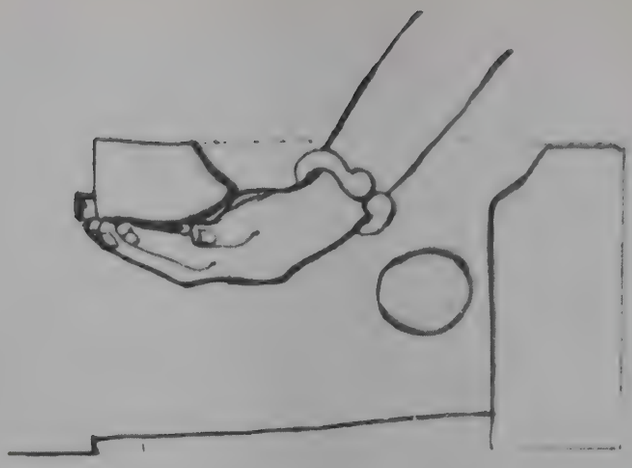
5.8. Is width and depth of firebox correct?

The width and depth of the firebox should not be more than the hole above it.



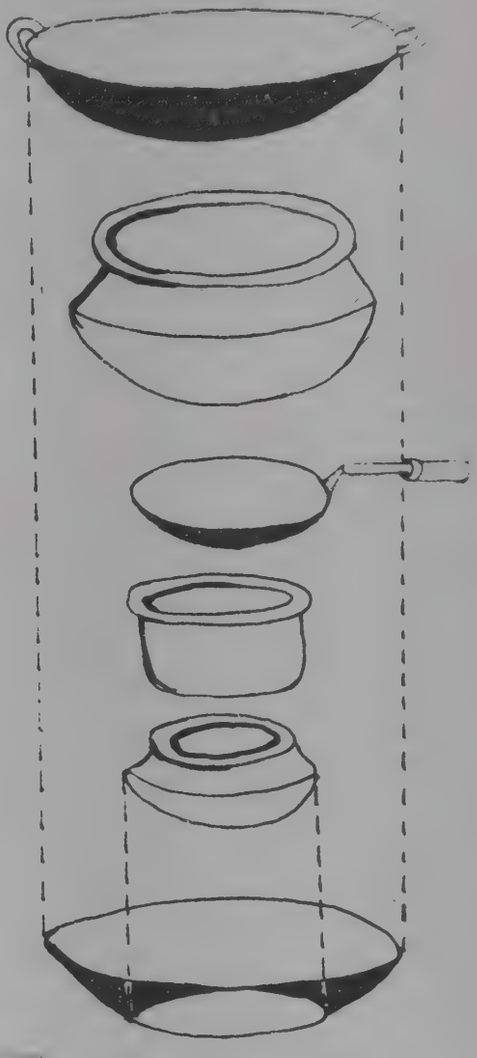
5.9. Is ceiling of firebox bridge alright?

This should be checked by opening the front dampers and feeling the bridge ceiling. It should be sloping upwards towards the cooking hole.



5.10. Are cooking holes shaped correctly?

This should be checked by placing commonly used pots of different sizes in all cooking holes. No gaps should remain between hole edges and any of the pots. The hole diameters should be as big as possible.

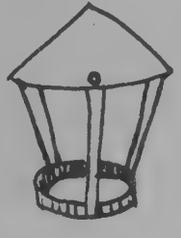


5.11. Are front dampers fixed correctly?

This should be checked by opening the dampers fully and making sure that no gara has fallen off or sagged from inside while fixing the guides. The dampers should also slide easily. No guide should project beyond the chulha sides or into the firebox opening.

5.12. Has mud been stuffed between chimney and thatch?

This **MUST** be checked where the kitchen has a thatched roof.



5.13. Has the cowl been placed in position correctly?

Before leaving the chulha, the chimney damper should be opened completely and the front damper partly. Air circulation through the chulha will help it dry faster.

Chapter 5

CHAAPRI LAYOUTS FOR DIFFERENT CHULHA TYPES

This chapter should help trainers guide trainees in planning chaapri layouts for different types of chulhas. A number of plans of the main chulha types have been given. These show the steps in which the chaapris should be fixed and the main construction stages described in chapter IV. If trainers help trainees move step by step, they will become confident quickly. During five training courses for mistris, trainees found the trial edition of this chapter the most useful. When building chulhas on their own, both during and after training, they used its plans for constant reference.

While teaching and supervising chaapri planning, trainers should emphasise that the position of the chulha's outer chaapris should be marked first. The position of inner chaapris should be fixed only after that.

Another principle is to **always** make trainees use normal kitchen pots as the basis for detailed chaapri layouts. Whether the distances between pots, and diameters of cooking holes are correct, can be judged only in relation to these. If no pots are used, even trainers will find it difficult to judge whether the chulha is planned correctly or not. As has been said earlier, the Nada Chulha is an adaptable design system and **not** a standardised chulha with a fixed size. The tendency among some trainees to measure one chulha and remember its size must be strongly discouraged. Instead, thinking and planning according to need has to be encouraged.

During a training course, it will not be possible to deal with all the chulha types given in the chapter. Instead, most of the teaching and practical work should be based on one or two types most suitable for the area in which the course is held. For example, in Himachal, the 3-holed chulha with two tunnels and the 2-holed chulha with holes one behind the other can be used for the main training. In Punjab and Haryana, the 2-holed chulha with holes one beside the other and the chulha with a *hara* should be used for practical work. In other areas, 2 or 3 different layouts of the 2-holed chulha with both solid and hollow construction can be used. Other chulha types can be simply demonstrated during a session towards the end.

INTRODUCTION

This chapter gives guidelines for doing chaapri layouts for some common variations of the Nada Chulha. It also tells when and where they should be used. Approximate quantitites of materials needed, suitable chimney diameters and the position and sizes of holes to be cut in chimneys, are also given. Mistris and suprvisors can choose chulhas suitable for different situations with the help of the chapter.

Most of the chulha types have already been used a lot in different states. Some have been developed for special needs by supervisors. All have originated from the needs and priorities of different users.

This is not a closed list. With more trained mistris, supervisors and trainers taking the chulha to new areas, new variations will be developed and introduced.

GENERAL GUIDELINES

General principles for planning chaapri layouts have already been given in 3.3 Chapter IV. While planning a layout, it is useful to divide chaapris into two groups.

1.1. Outer chaapris

These fix the outer shape and size of the chulha - whether it is to be rectangular, square, L-shaped, T-shaped, triangular (in a corner) or with an attached platform. This depends on the user's liking and space available in the kitchen. Outer shapes and sizes of chulhas can be varied infinitely. Chaapri layout should always be started by marking positions of outer chaapris.

1.2. Inner chaapris

These are used to shape the firebox and tunnel inside the chulha. They must fit within the outer chaapris. Their planning needs to be done with more care according to the principles given in 3.3 of chapter IV.

1.3. Guide to chaapri plans.

The following section has a number of plans for different chulha types. For each type, 6 stages are shown. Each stage is indicated by a big number on one side of the plan. The line at the top of each plan indicates a wall.

Plan 1. This shows the chimney and two or three commonly used pots placed in the position where cooking holes and the firebox are to come. Desirable distances between holes, between the damper and chimney, and between pots and wall are shown in finger measurements.

The dotted lines show the position of outer chaapris. The small numbers next to the lines give the sequence in which these should be marked.

Plan 2. This shows a sequence and method for deciding the position of inner chaapris. Let us use chulha type 2 as an example. The two dotted circles show the position of cooking holes marked around the pots placed there earlier. It is easier to start by marking chaapri positions for the back wall of the tunnel. This can be done by joining the outermost points of the holes. Then the outer point of the second hole can be joined to the outer side of the chimney. Next the other side of the chimney is joined with the other outer point of the second hole. The firebox width should be kept 1" (25 mm) to 1½" (37 mm) wider than the final hole size to come above. This will leave room for gara yet to be applied on chaapris. The width of the tunnel mouth is indicated by a small closed fist (about 4" or 100 mm). Where the firebox is on one side of the chulha, an extra chaapri can be fixed 2 inches (50 mm) away from, and parallel to, the outer chaapri of the firebox. This will provide enough surface along which the front damper can slide. The chaapris can be fixed in these positions.

For 3-holed chulhas with one or two tunnels, or for a chulha with a hara, chaapris can be laid as shown.

Plan 3. This shows the structure of all chaapris fixed in position. Gara has been applied inside the tunnel and firebox to give them final shape. Gara thickness has been shown by dark shading. The chimney damper is shown cutting into the gara on both walls of the tunnel.

Plan 4. This shows dry earth filled inside the

hollow spaces, gara applied on outer chulha walls and the metal support placed in position across the firebox mouth.

Plan 5. This shows the position of 'roofing' chaapri pieces across the tunnel and firebox mouth.

Plan 6. This shows the finished chulha from the top. The position of baffles inside cooking holes is shown. Dotted lines show the firebox opening and final shape of the tunnel.

Note:

In some cases some of the above stages have been combined into one plan to avoid repetition. In such cases, the numbers on the side indicate which stages are shown in the same plan.

2. TWO-HOLED CHULHA, SOLID CONSTRUCTION

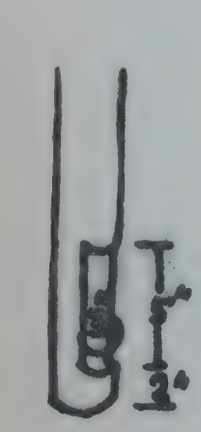
This is the simplest and most popular chulha type in the plains of Punjab, Haryana, U.P., Rajasthan and Gujrat. The two holes can be one beside the other or one behind the other. It can also be built in a triangular shape in a corner. The chimney can be at one end or in the centre behind the cooking holes. Platforms for shelf space can be attached to either side of the chulha. All dead spaces are filled with ordinary dry earth.

A trainee learning chaapri layout with the help of the book.

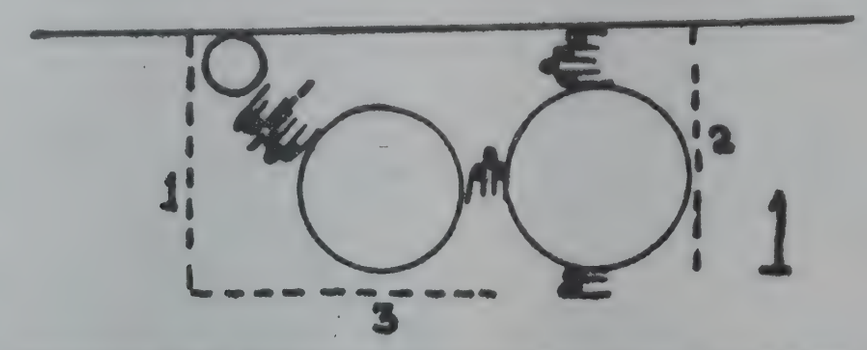
Chimney diameter	: 3 inches (75 mm)
Chimney length	: kitchen height plus 2 to 3 feet (600-900 mm)
Chimney damper	: One
Hole size to be cut in asbestos cement chimney	: Width-3 inches (75 mm) Height-5 inches (125 mm)
Number of chaapris	: 8 to 9 of 15" × 7" × ¾" (375 × 175 × 20 mm) size with one cut into smaller pieces for roofing the tunnel.
Gara	: Approx. 3 taslas (baskets)
Dry earth	: Approx. 2 taslas.

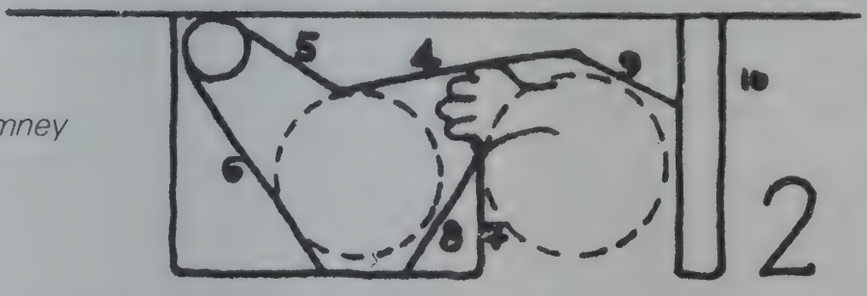
2a. Two-holed chulha, solid construction

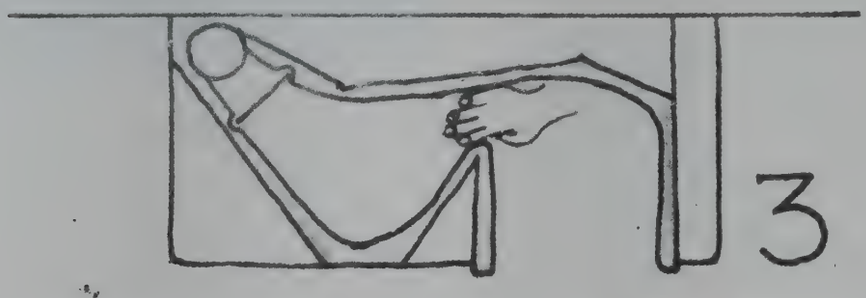
Holes one beside the other, cook's sitting position to right of firebox.

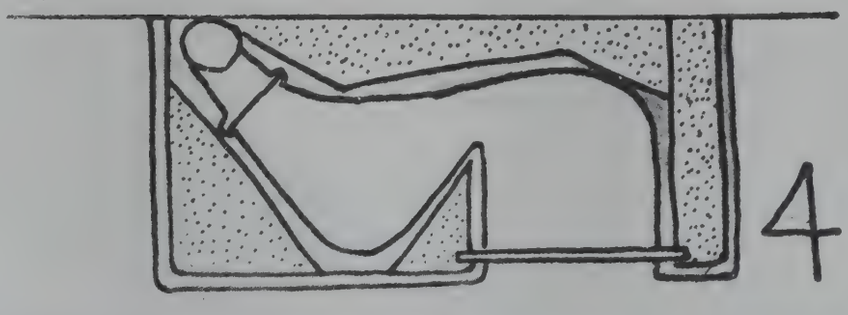


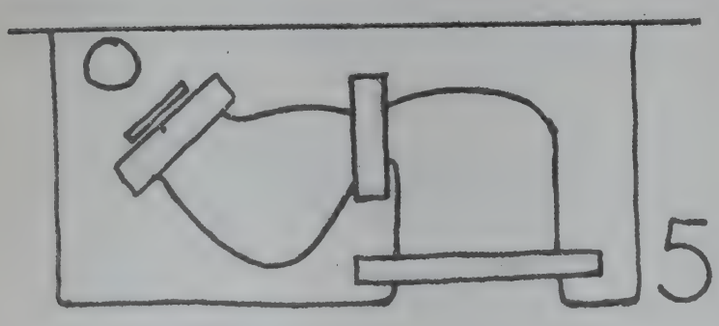
Hole cut in chimney

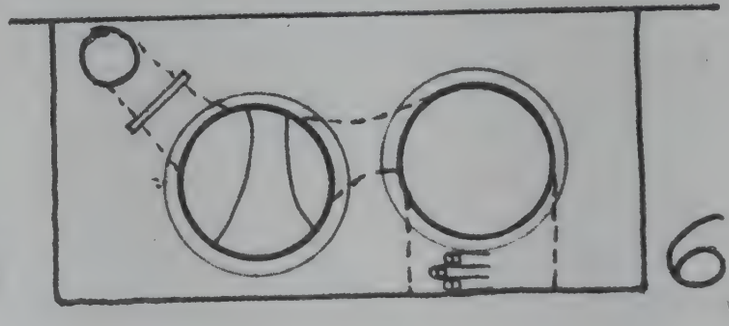






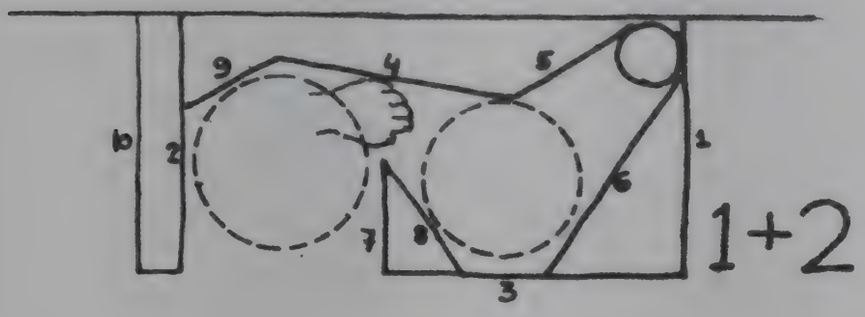


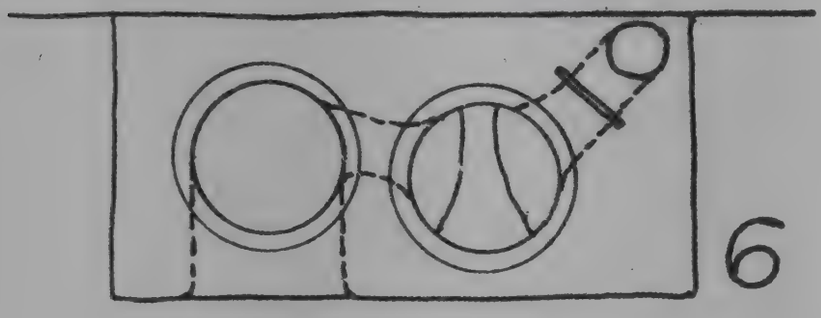


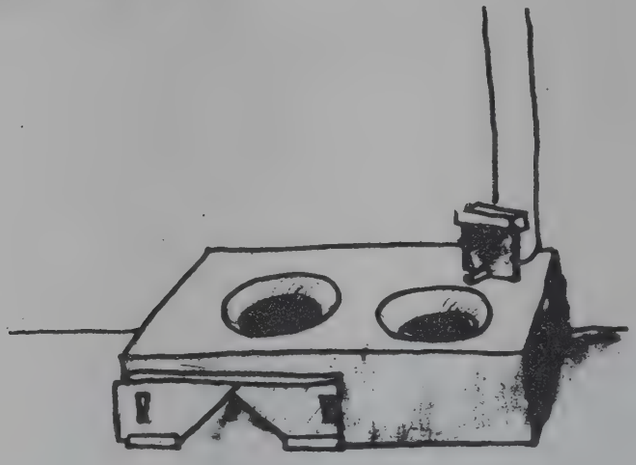


2b. Two-holed chulha, Solid construction

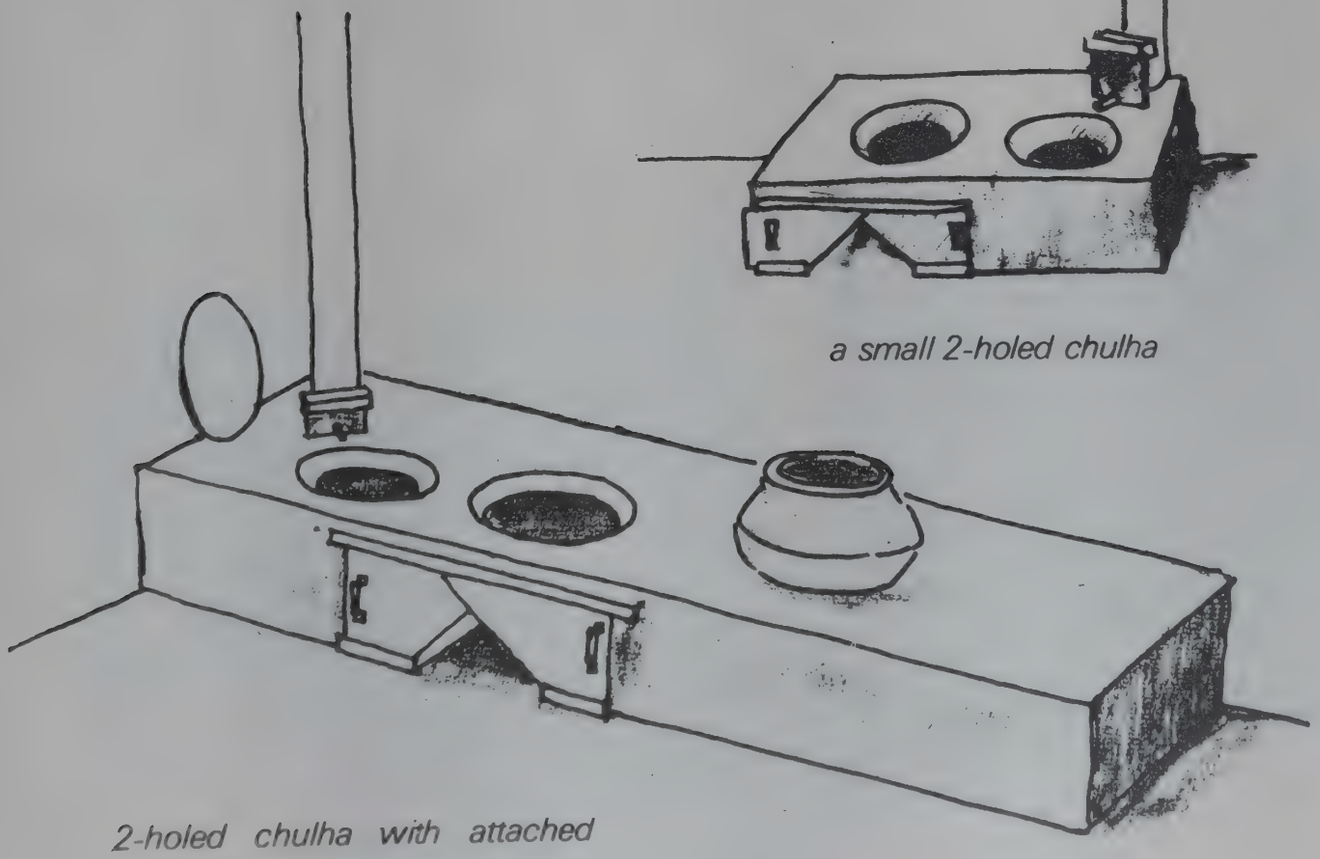
Holes one beside the other, cooks sitting position to left of firebox.







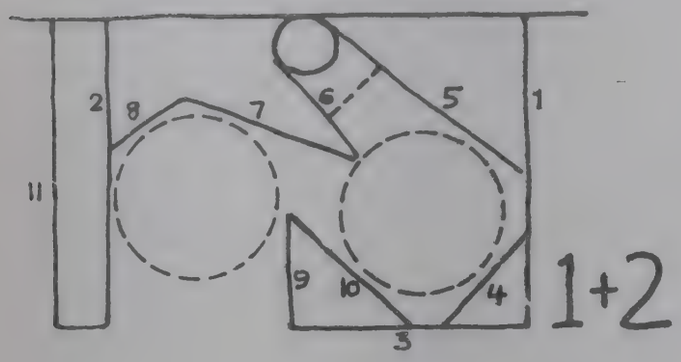
a small 2-holed chulha



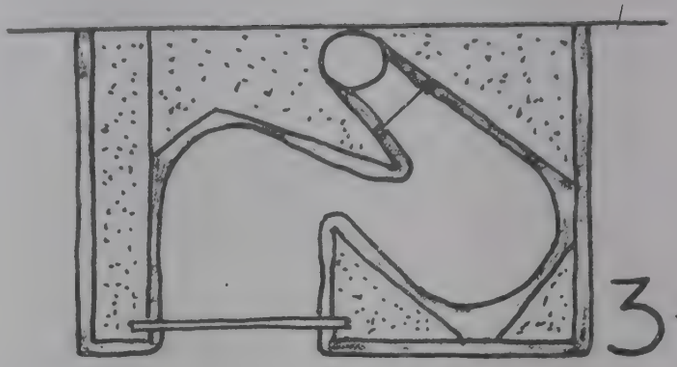
2-holed chulha with attached platform.

2c. Two-holed chulha, solid construction

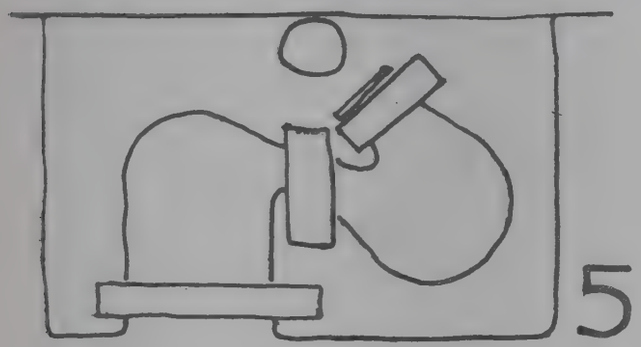
Holes one beside the other, chimney in centre.



1+2



3+4



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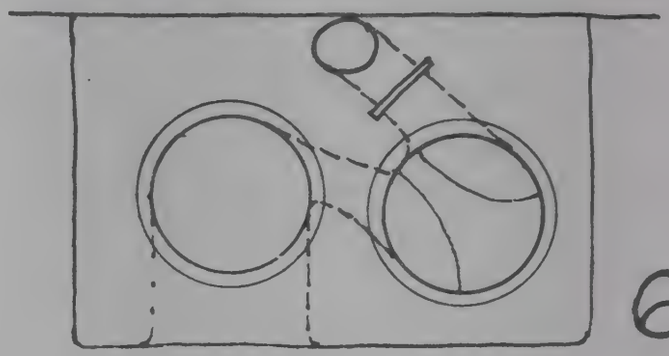


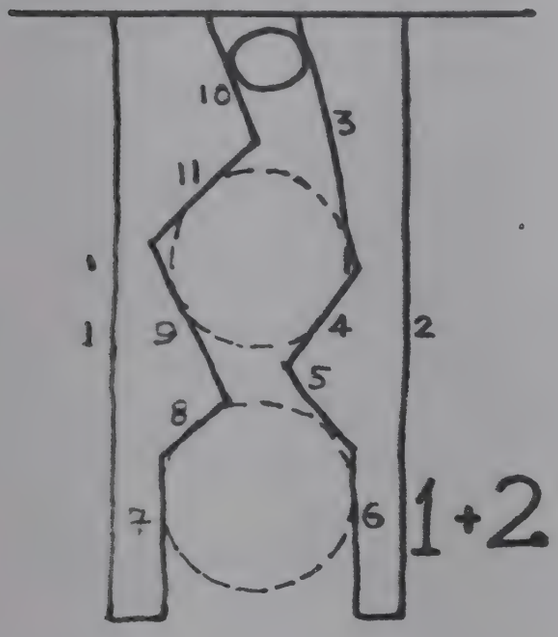
6

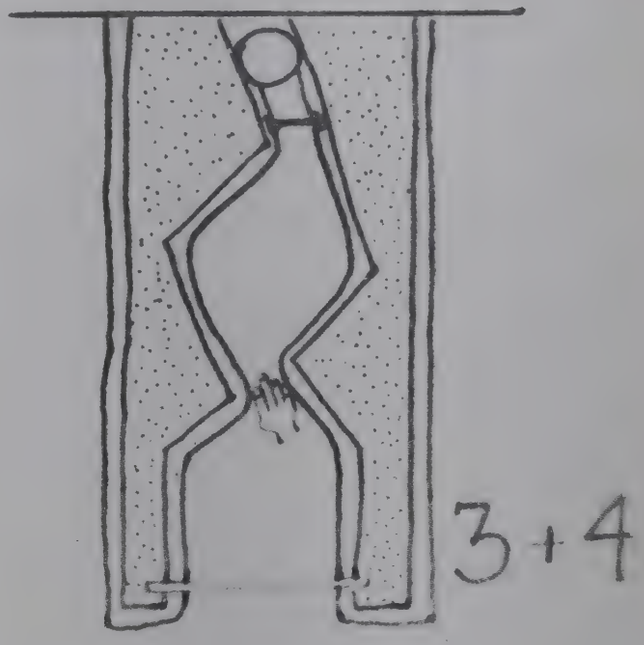
chaapri layout of a 2- holed chulha in a corner.

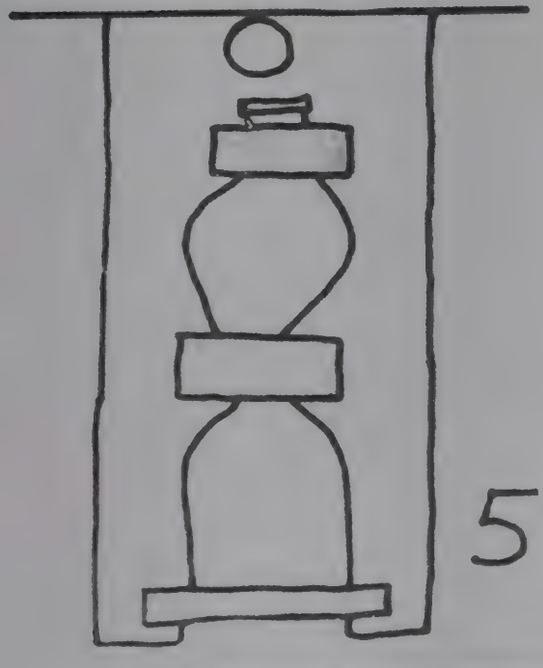
the same chulha when finished.

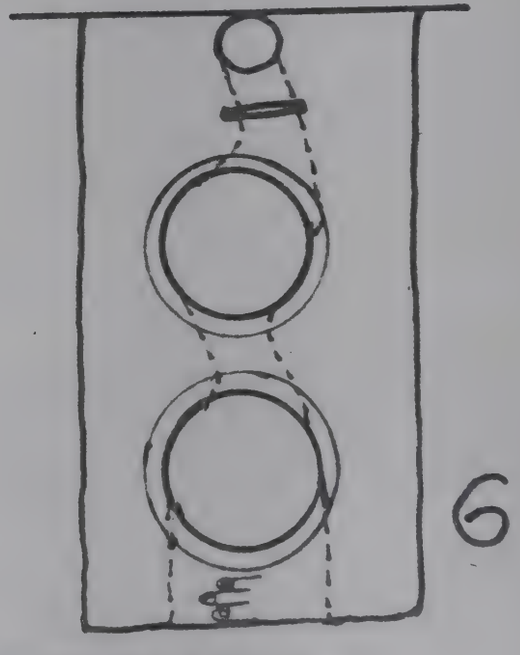
2d. Two-holed chulha, solid construction

Holes one behind the other, cook's sitting position on either side of firebox.







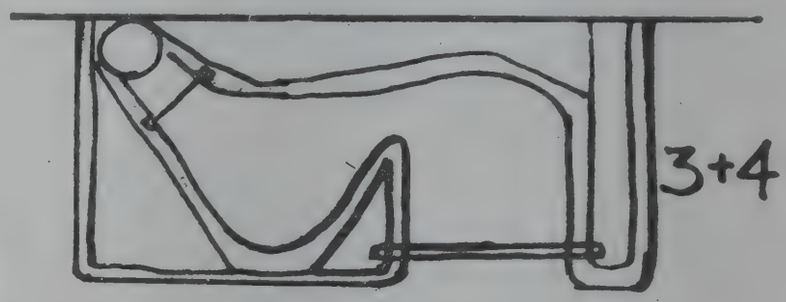


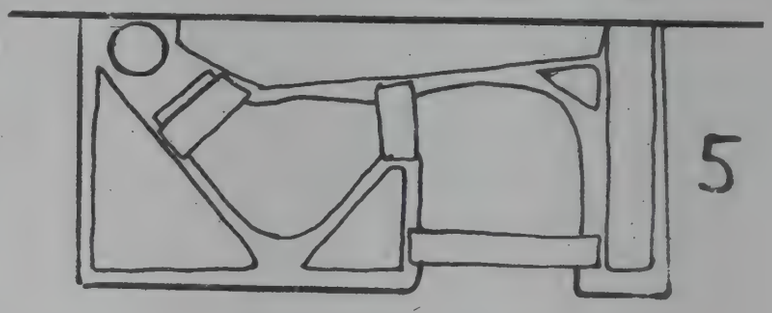
3. TWO-HOLED CHULHA, HOLLOW CONSTRUCTION.

The Nada Chulha construction method makes it possible to keep the dead spaces of any of the chulha types hollow. Instead of filling dry earth into them, they can be roofed over by chaapri pieces. How to build a 2-holed chulha with hollow construction is shown in the illustrations. The only care to be taken is that where wide hollow spaces are to be roofed, more supports should be provided for the roofing pieces.

Number of chaapris	: 9 to 10 of 15" × 7" × ¾" (375 × 175 × 20 mm) size with two cut into smaller pieces for roofing
Dry earth	: approx. ½ tasla
Everything else as for 2-holed chulha with solid construction.	

Hollow construction chulhas are best for small families who use the chulha for short times with long gaps in between. They are also good for families who do not use retained heat in the chulha body for keeping things warm. Some chulhas of this type have been built in Haryana and H.P. Users have resisted large scale adoption of this method out of fear that it will make the chulha weak. However, where used, there have been no problems with the chulha's strength





A hollow chulha ready for closing from above. The finished chulha will look like a solid chulha.

Two traditional haras.

A pit dug on the right side of the chulha for a partly sunk in hara.

The hara finished at the same level as the chulha

The hara cover placed in position.

4. TWO-HOLED CHULHA WITH HARA

A *hara* is a traditional device used in high milk producing villages of Punjab, Haryana and western U.P. for slow heating of milk. It is basically a cylindrical enclosure inside which the milk pot is placed on a slow fire of dung cakes. Smoke escapes through the open or semi-covered top of the hara after passing around the sides of the milk pot. Some people cook even lentils and spinach in the hara. They enjoy the special taste given by the smoke and slow cooking. Haras are either fully or partly dug into the ground. They are also built totally above ground. They produce a terrible smoke for several hours every day.

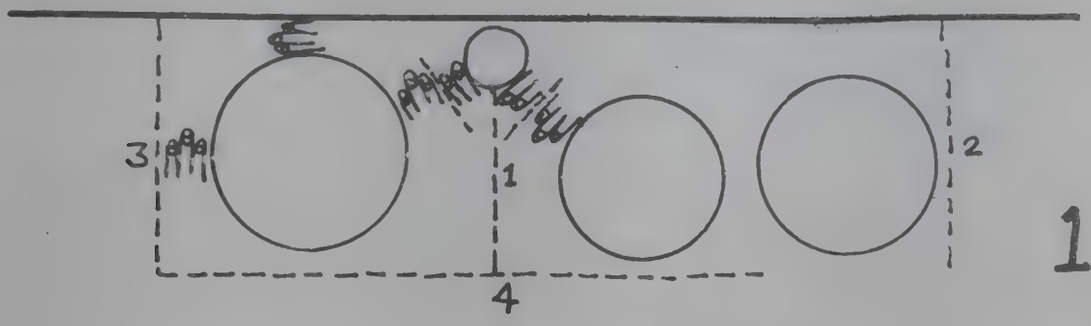
A hara can be easily attached to the chimney of a 2-holed chulha. The only requirement is that there should be space for it next to the chimney on a side of the chulha. As the pot has to be lifted in and out of the hara, its inside diameter should be at least 2 inches (50 mm) more than that of the milk pot. If a hara finishes at the same level as the chulha, it is necessary to dig a pit inside it. The inside height of the hara should be at least 6 inches (150 mm) more than the height of the milk pot. This is to leave enough space for ashes and dung cakes under the pot. A tunnel just below the hara top has to be made and connected to another hole in the chimney. The tunnel should be straight, short and of at least 3" (75 mm) diameter. This makes cleaning it easy. When the mouth of the hara is covered, all the smoke goes out through the chimney. Nada chulhas with attached haras have become very popular in parts of Haryana, Punjab and lower areas of Himachal Pradesh.

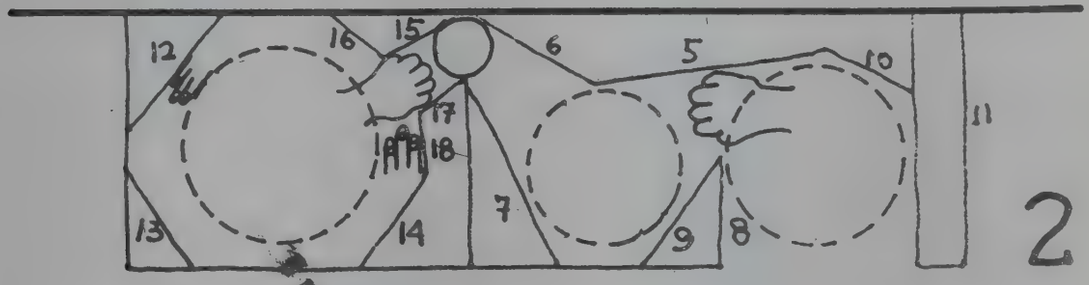
4.a. 2-holed Chulha with partly sunk-in hara.

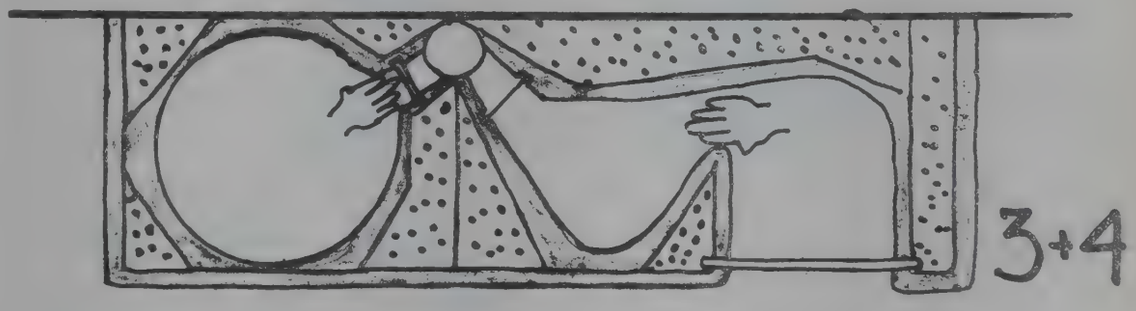
Chimney diameter	:	3 inches (75 mm) or 4 inches (100 mm).
Chimney dampers	:	Two.
Hole to be cut in A.C. chimney	:	One large hole 8 inches (200 mm) wide and 5" (125 mm) high.
Number of chaapris	:	12 to 13 of 15" × 7" × ¾" (375 × 175 × 20 mm) size with one cut into smaller pieces for roofing tunnels.
Gara	:	Approx. 5 taslas.
Dry earth	:	Approx. 3 taslas.

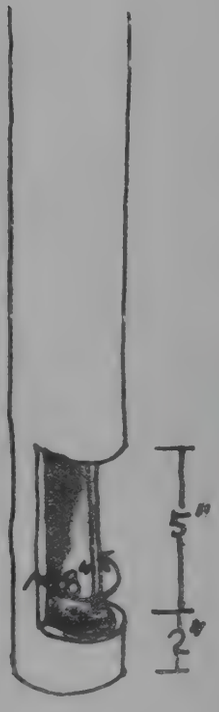
The chulha and hara being roofed (above) and, the finished chulha with hara (below).

2-holed Chulha with partly sunk-in hara.

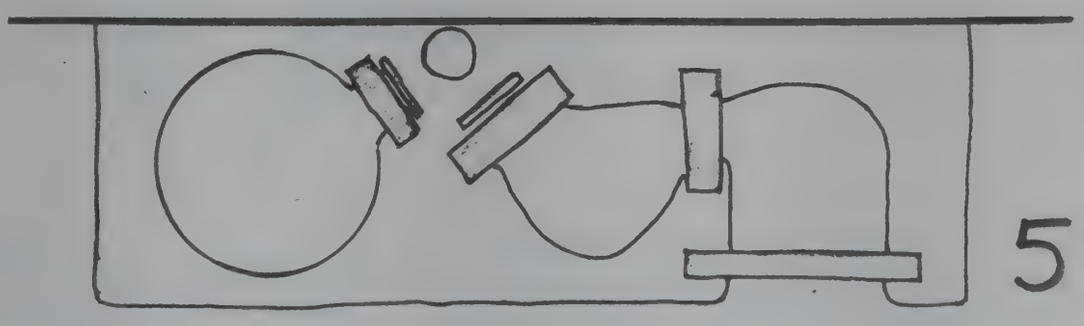


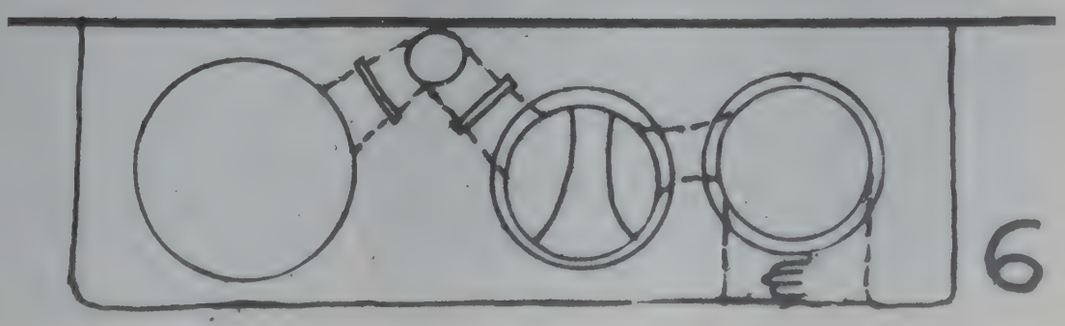






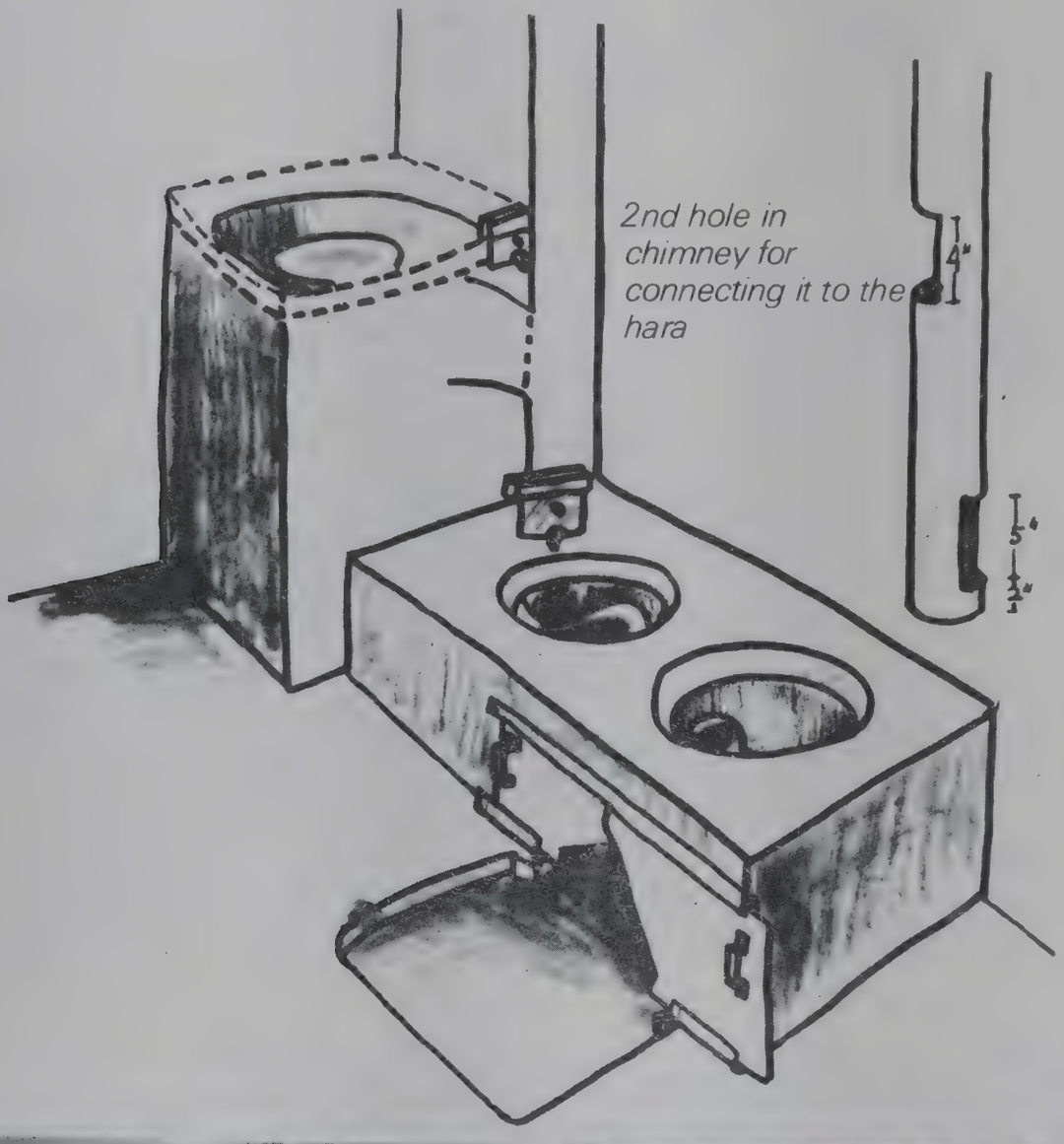
hole cut in chimney





4.b. 2-holed chulha attached to pre-fabricated hara above ground.

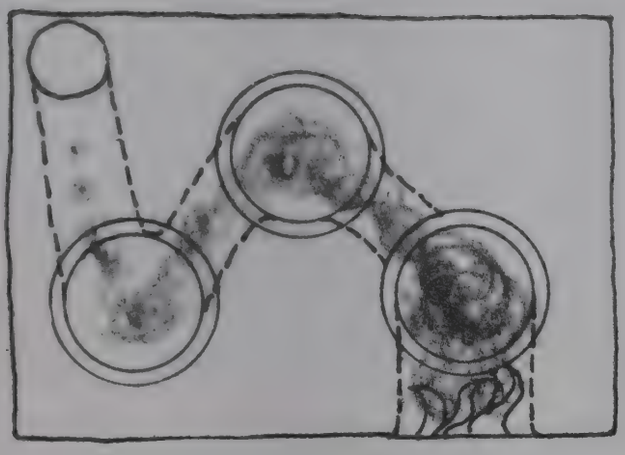
Frequently, women want to attach their existing haras to the Nada Chulha. This can be done easily by cutting another hole in the chimney just below the top of the hara. A hole has also to be cut in a hara wall at the point where it is to be connected with the chimney.



The chulha with hara shown above with the cover of the hara kept open.

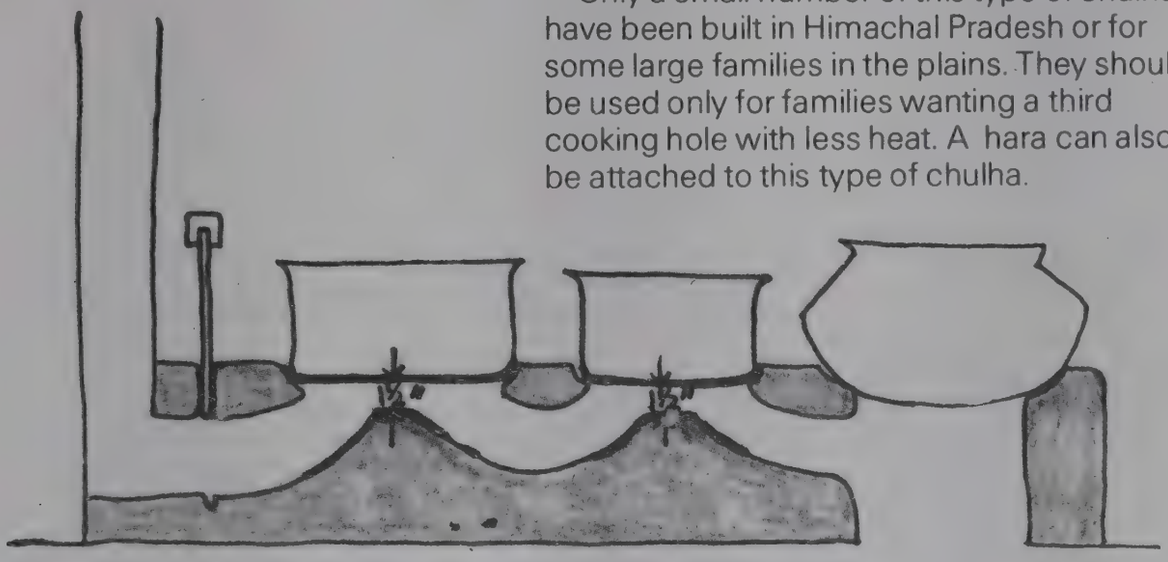
Another existing hara attached to a new chulha.

5. 3-HOLED CHULHA WITH ONE TUNNEL.



This has a longer tunnel between firebox and chimney to fit a third cooking hole. The tunnel can be linear, Z or L shaped with the outer shape being rectangular, square or L shaped. The last hole in this chulha type gets less heat as the hot gases become cooler on reaching it. This hole cannot be used for cooking but will keep food warm. The longer tunnel also increases the chulha's flow resistance. Therefore the chimney draft is less. Because of this the gap between pots and baffles in 2nd and 3rd cooking holes should be increased to 1"(25 mm) to 1½" (38 mm). This in turn results in less heat being transferred to pots in the additional cooking holes.

Only a small number of this type of chulha have been built in Himachal Pradesh or for some large families in the plains. They should be used only for families wanting a third cooking hole with less heat. A hara can also be attached to this type of chulha.

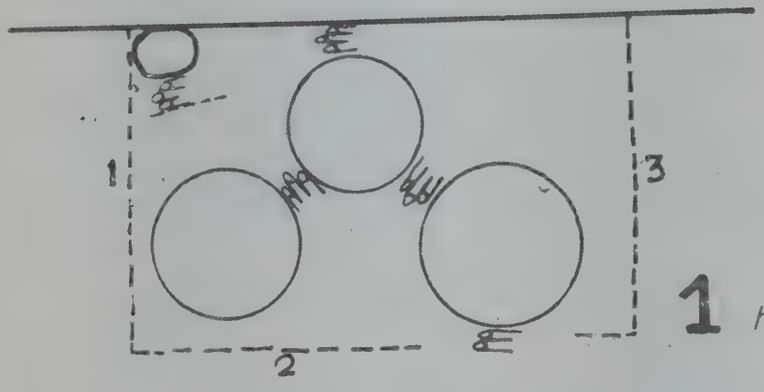


A one tunnel 3-holed chulha with holes in a line.

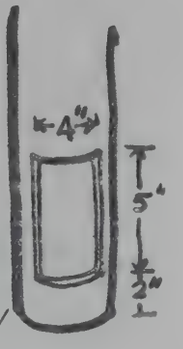
A 3-holed chulha with a Z-shaped tunnel.

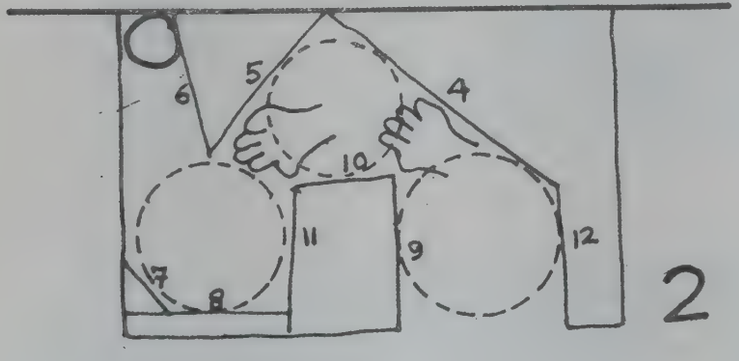
5.a. Square 3-holed chulha with single tunnel.

Cooks' sitting position	:	Right side of firebox or to its left in front of chulha. Both left and right hands can be used for cooking.
Chimney diameter	:	4 inches (100 mm).
Chimney damper	:	One.
Hole size in A.C. chimney	:	Width 4" (100 mm) height-5" (125 mm).
Number of chaapris	:	8 to 9 of 21" × 7" × ¾" (525 × 175 × 20 mm) size, with one cut into smaller pieces for roofing tunnel.
Gara	:	Approx. 5 taslas.
Dry earth	:	Approx. 4 taslas.



1 *hole cut in chimney*





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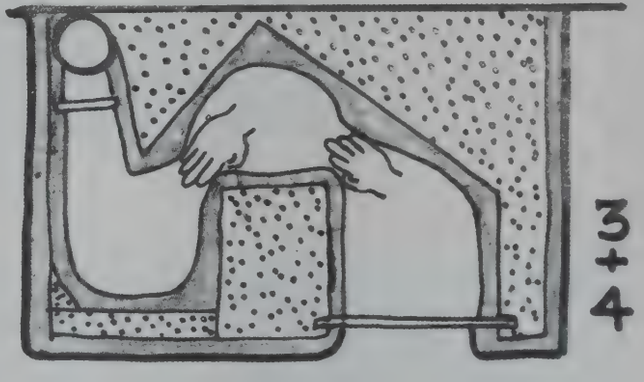

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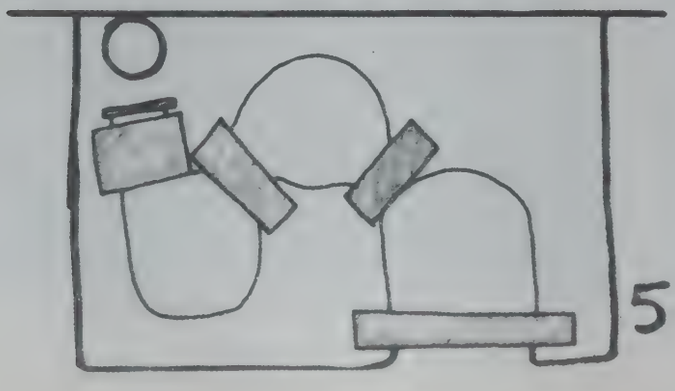

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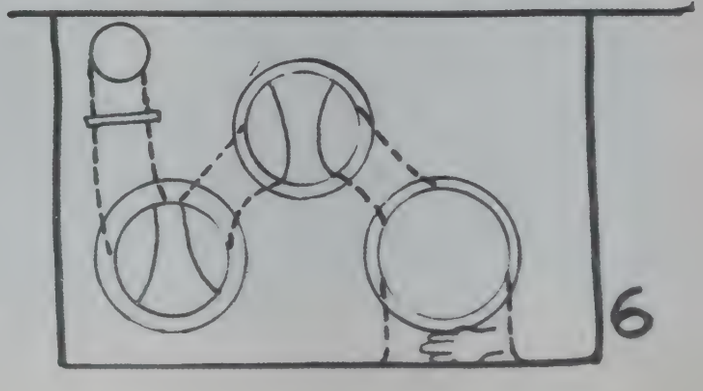

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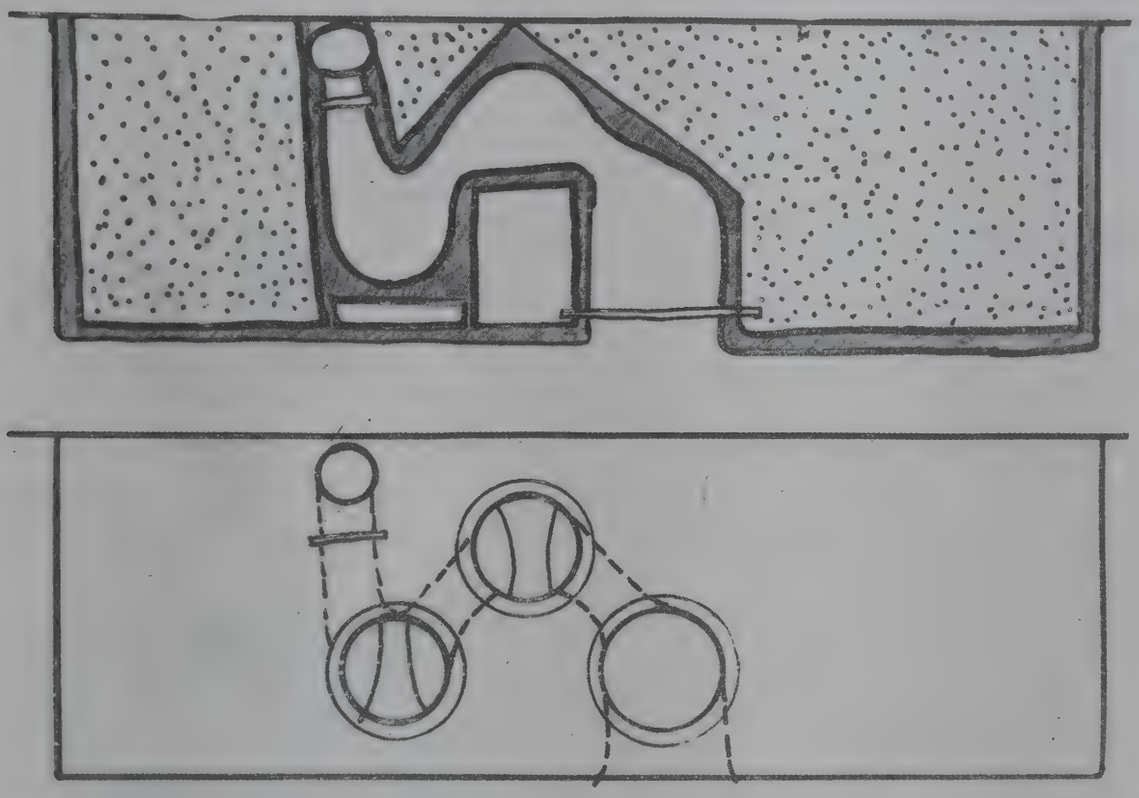
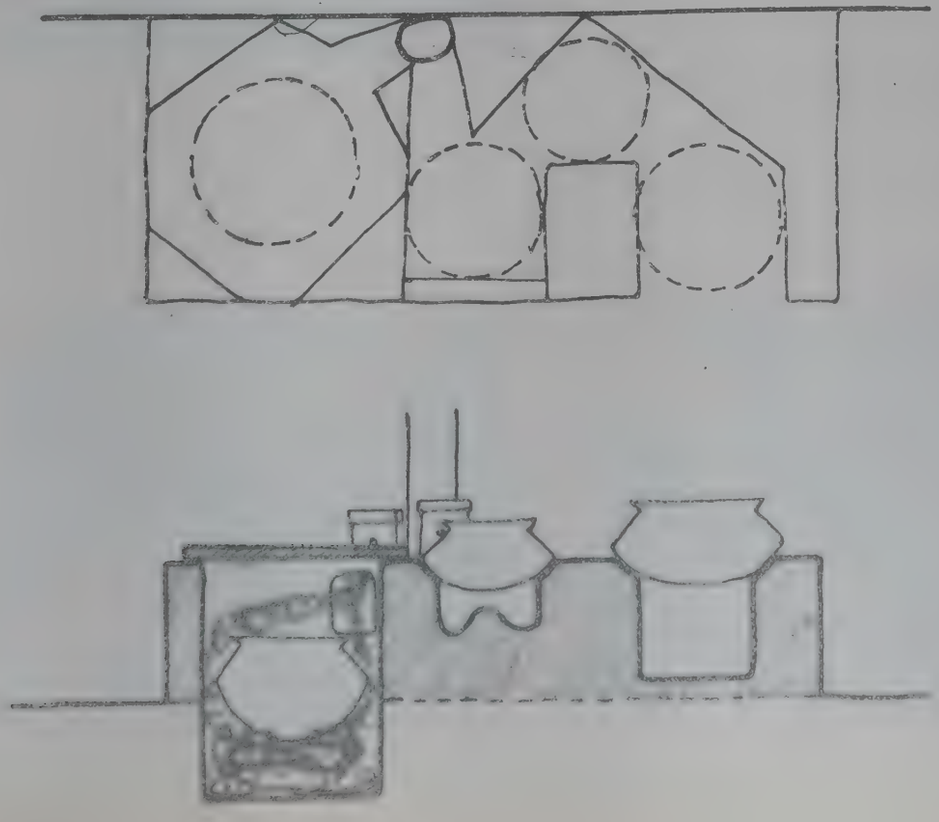
5.b. 3-holed single tunnel chulha with platforms on both sides

This will require additional chaapris, gara and dry earth according to the size of the platforms.



5.c. 3-holed single tunnel chulha with sunk-in hara.

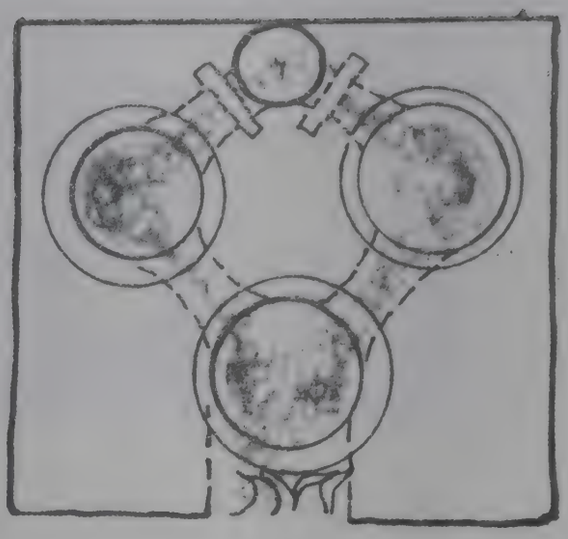
This will also require more chaapris and gara and two chimney dampers. One large hole 9" (225 mm) wide and 5" (125 mm) high should be cut if an asbestos cement chimney is used.



6. 3-HOLED CHULHA WITH TWO TUNNELS.

This has its firebox connected to the chimney with two separate tunnels with a cooking hole above each. Both tunnels have chimney dampers between chimney and second hole. The outer shape can be square or T-shaped.

This chulha type is very popular in Himachal Pradesh. It provides heat enough for cooking in all three holes. As both tunnels are short and of equal length, flow resistance is also less. The gap between baffles and pot bottoms can be only ¾" (20 mm). Users report big reductions in cooking time and fuel consumption. The overall cooking efficiency of this chulha is better than that of type 5. When only two holes need to be used, the third one can be shut off by closing the chimney damper next to it.

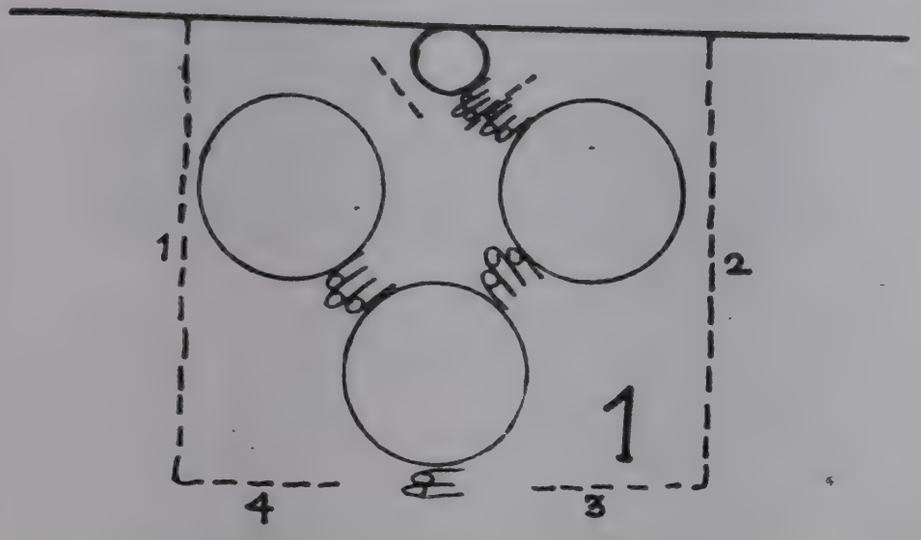


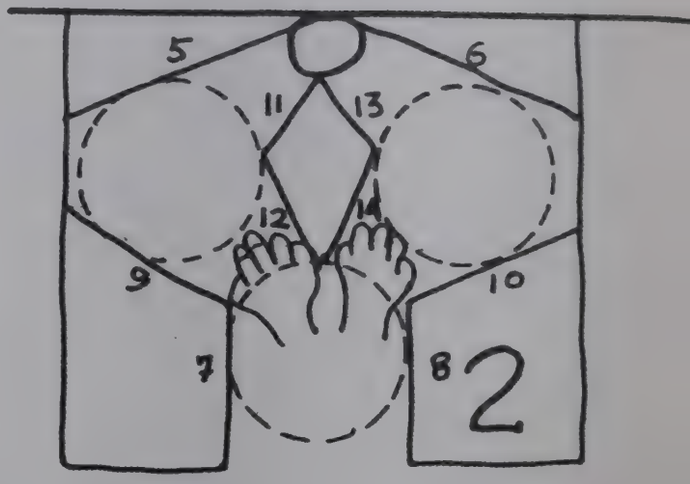
6.a. 3-holed chulha with two tunnels, square shaped.

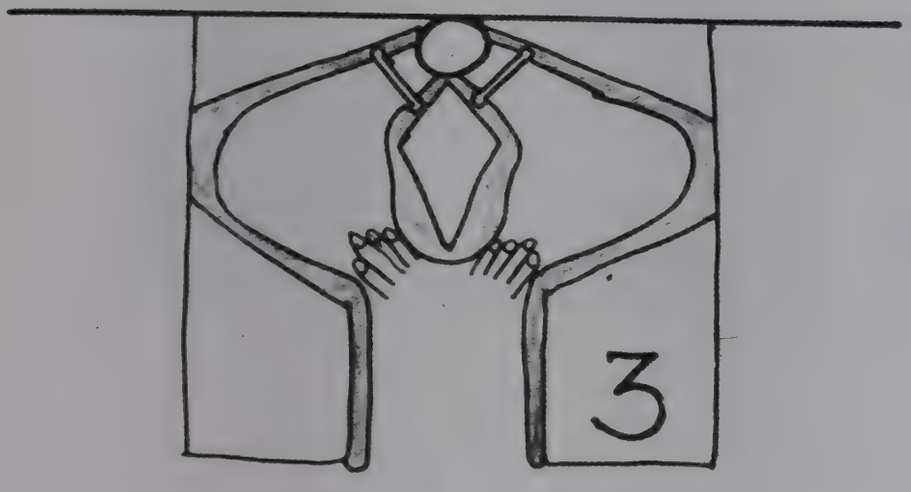
Cook's sitting position	:	To left or right of firebox in front of chulha.
Chimney diameter	:	4 inches (100 mm)
Chimney dampers	:	Two
Hole size in A.C. chimney	:	Width 9 inches (225 mm) Height 5 inches (125 mm).
Chaapris, gara and dry earth required	:	as for type 5.

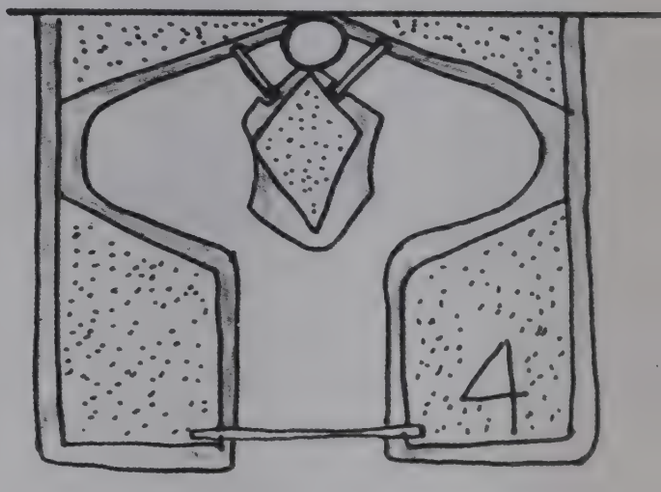
Chaapri layout for a square 3-holed chulha with 2 tunnels

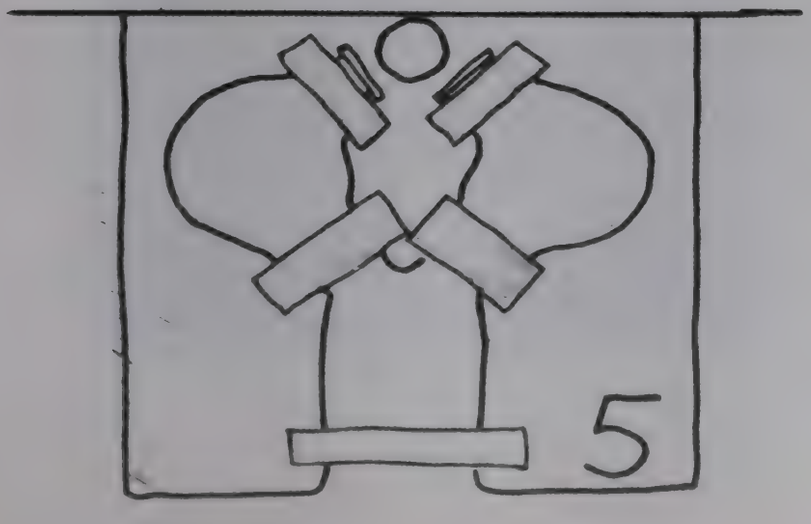
6.a. 3-holed chulha with two tunnels, square shaped.

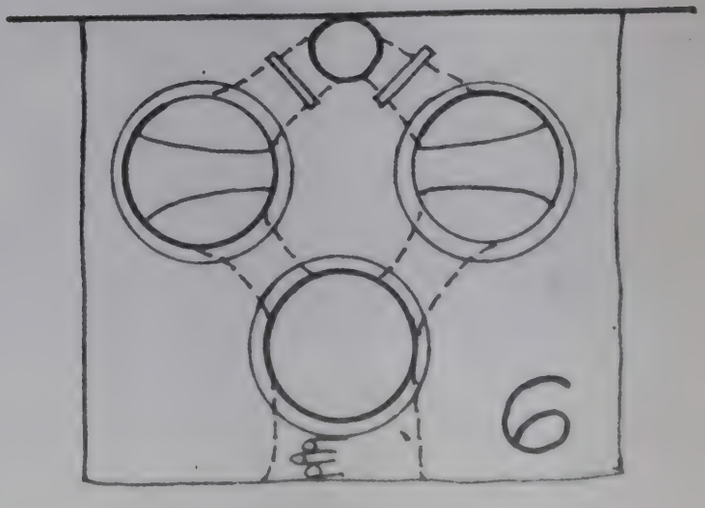




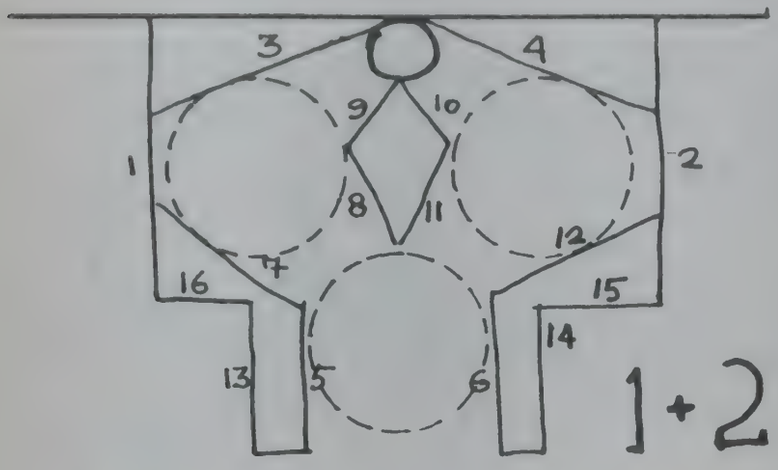


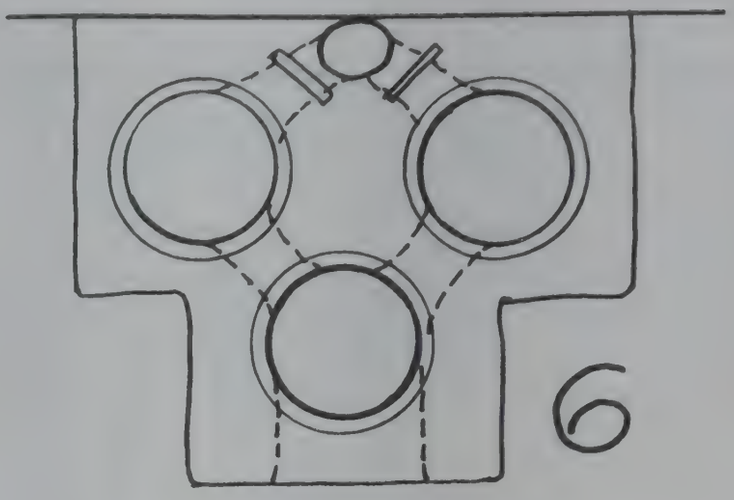






6.b. 3-holed chulha with two tunnels, T-shaped.





A trainee learning chaapri layout for the chulha

A chulha in use.

A T-shaped chulha fitted into an existing fire place.

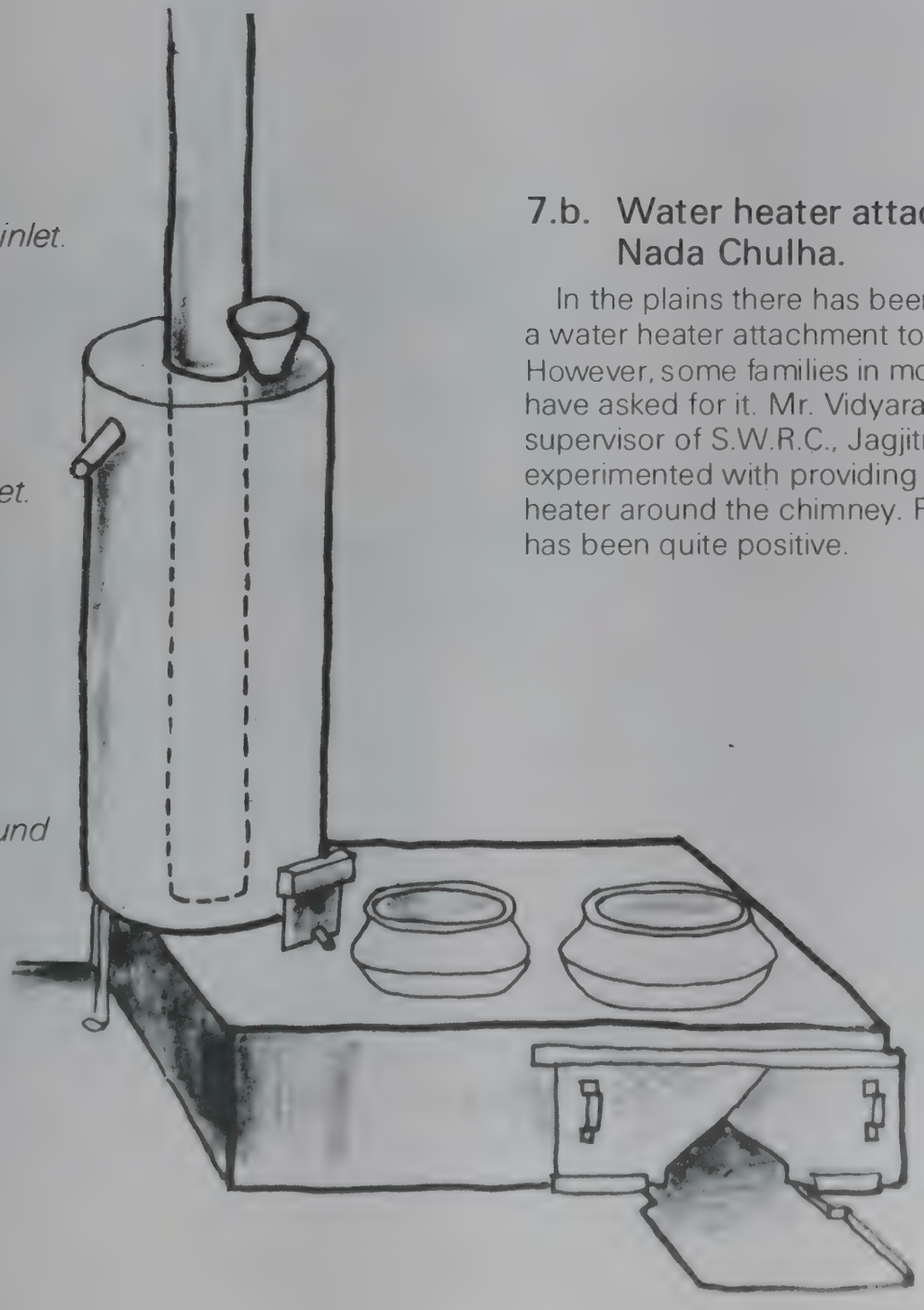
7. MISCELLANEOUS

7.a. Nada Chulhas with a grate.

It is easy to fix a grate in the firebox of any Nada Chulha. However, very few Nada Chulhas with grates have been built because of user resistance. This is due to the tradition of keeping the fire alive in between cooking by burying it under ashes. A grate makes this difficult.

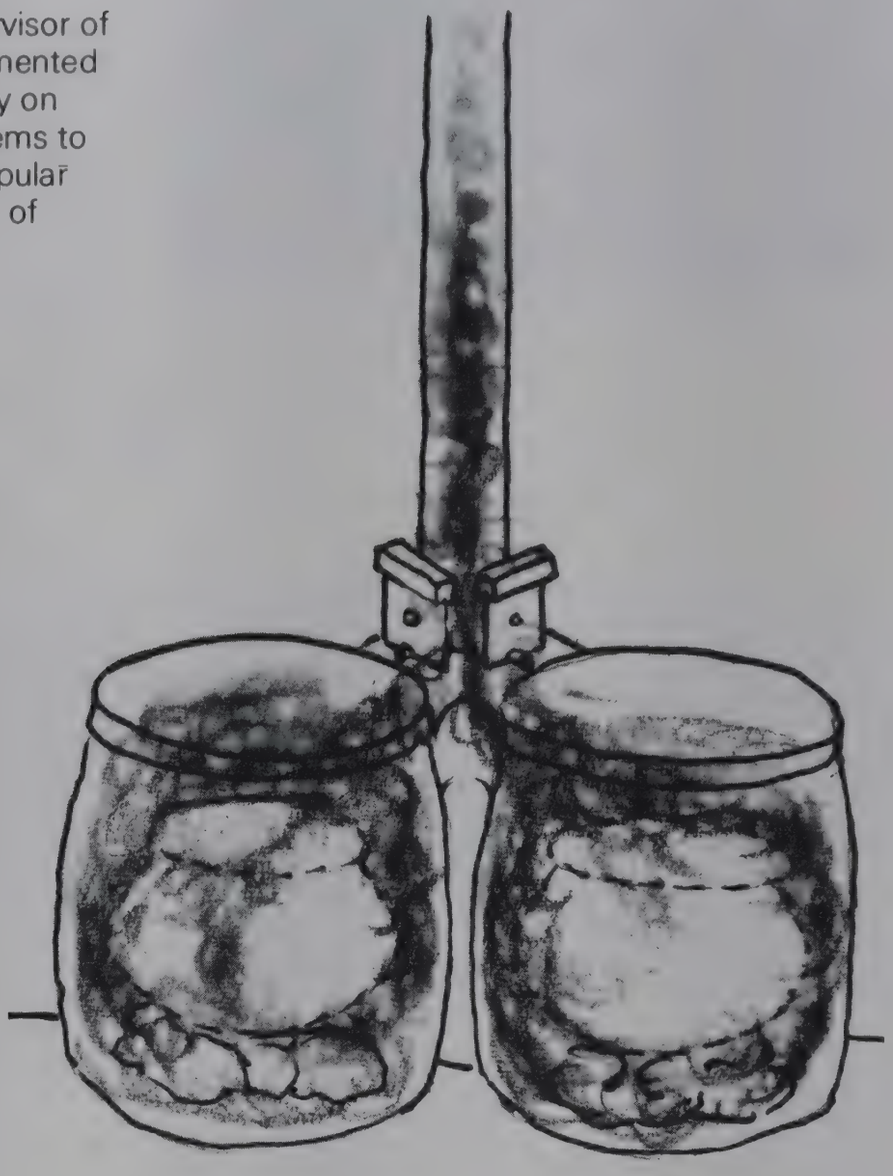
7.b. Water heater attachment to the Nada Chulha.

In the plains there has been no demand for a water heater attachment to the chulha. However, some families in mountainous areas have asked for it. Mr. Vidyarattan, a chulha supervisor of S.W.R.C., Jagjitnagar, has experimented with providing a metal water heater around the chimney. Feedback on it has been quite positive.



7.c. Two haras connected to a chimney.

Ms. Urmila Sharma, a chulha supervisor of Haryana SWRC, Nanwan, has experimented with attaching two *haras* to a chimney on special request. The arrangement seems to be working well and should prove popular among families having large amounts of surplus milk.



Two haras connected to a chimney.

Chapter 6

HOW TO USE AND MAINTAIN NADA CHULHA

This chapter has been divided into two sections. The first tells how the chulha can be used in the best way. The second deals with the maintenance necessary to keep the chulha working properly.

Trainers can introduce both sections on the 3rd or 4th day of the course. By then the trainees will be familiar with the chulha. They will also have some understanding of how its different parts function. This chapter can be used to emphasise the importance of proper use and maintenance and of making sure that users understand this. After all, using the chulha in the best way depends on the users.

To make it easier to teach chulha use and maintenance, an information sheet for users in the form of a wall paper has been developed. Trainers can use this during the discussion.

A trainee trying out a chulha built by her by cooking on it.

The introduction should be followed by cooking practice. During this, groups of 3 to 4 trainees can cook a complete meal on chulhas already in use in the training village. Supervisors will have to guide the trainees. Arrangements for this will have to be made with chulha owners.

During later practical work, trainees should be asked to check each chulha built by them during the earlier part of the course and light trial fires in them. Small changes necessary in some chulhas can also be made at this time. Trainees should also show chulha use to each new owner and explain how to maintain it with the help of the users' information sheet. Supervisors should help them do this systematically and make them get the habit of doing so before leaving any newly built chulha. Trainees should also leave a users' information sheet pasted at a safe but easily seen place in each house.

For teaching maintenance, a few houses with older Nada Chulhas needing chimney cleaning and small repairs should be found. Groups of 3 to 4 trainees can be taken to each house for maintenance practice. Even during this session, trainers should make the trainees explain maintenance to chulha owners.

INTRODUCTION

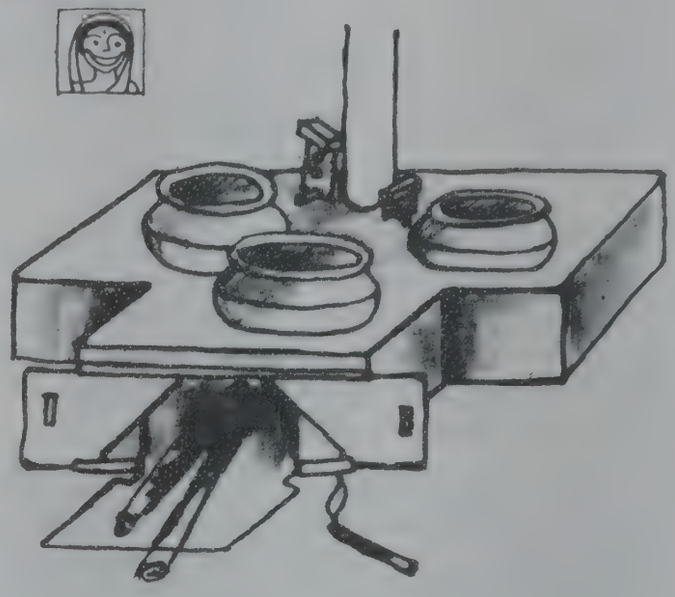
To use the Nada Chulha in the best way, its owners must understand how it works and how to maintain it properly. It is the responsibility of Chulha Mistris and Supervisors to teach them how to do so. This chapter deals with how this should be done.

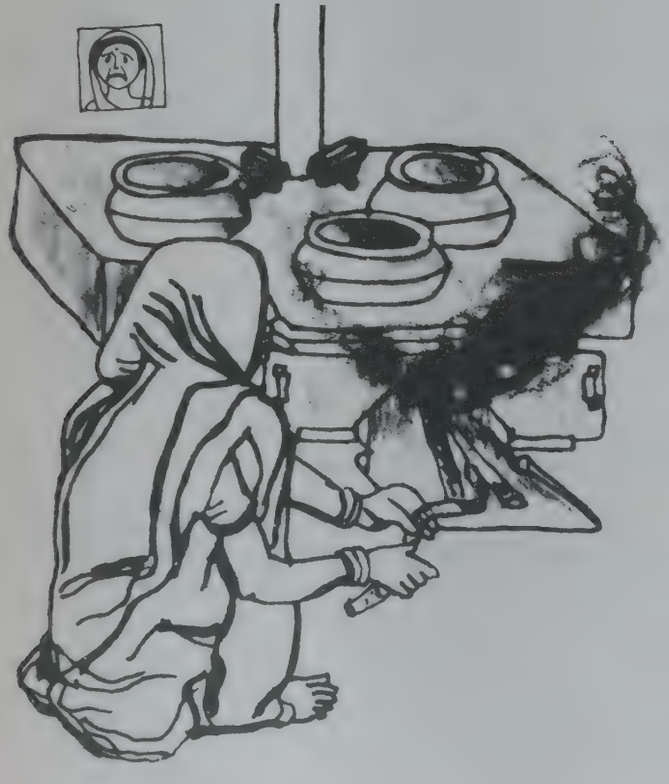
SECTION I

1. DAILY USE

1.1. Every morning, soot and ashes should be removed from the tunnel upto bottom of the chimney. This can be done with a *karchi* (large spoon) or by hand. For smoke to go out through the chimney, the tunnel must be clear.

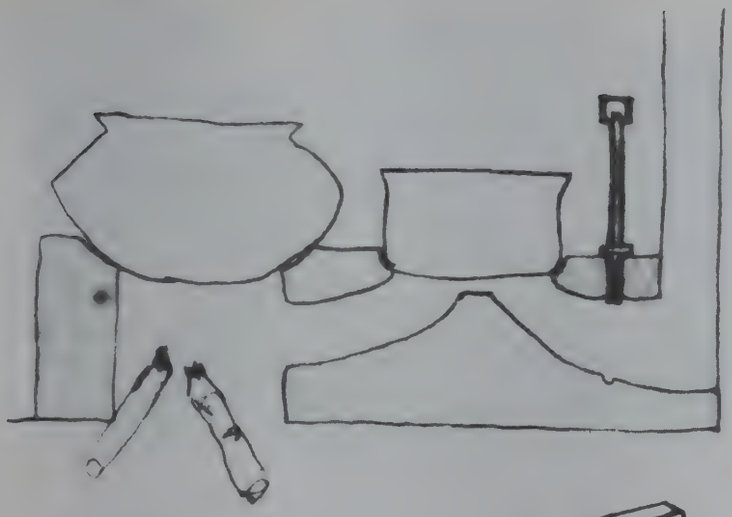
1.2. Before lighting the fire, all cooking holes should be covered with pots or covers. Both chimney and front dampers should be opened. In a 3-holed chulha with two tunnels, at least one chimney damper must be opened.





1.3. If any hole is left uncovered, smoke will come out through it.

1.4. If at least one chimney damper is not open, smoke will not be able to go up the chimney. It will also be difficult to light the fire as it will not have enough air for burning.



2. Use of chimney damper.

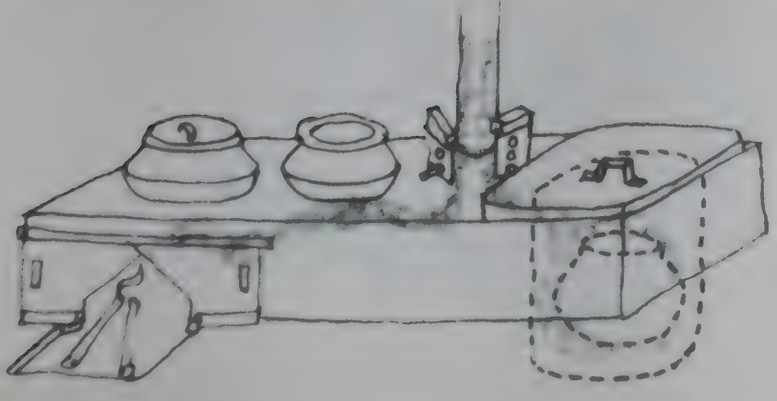
2.1. The chimney damper is meant to regulate chimney draft. When it is pulled up, the passage to the chimney is open. The chimney can pull out hot gases and smoke with maximum force. It should be kept in this position while lighting a fire so that the chimney pulls in the extra air required.

2.2. However, once the fire is burning well, the chimney damper should be lowered till the tunnel is almost closed. To set damper at correct position, it should first be lowered to a point when smoke and flames start coming out of firebox mouth. Then it should be raised just a little so that smoke stops coming back. The damper should be fixed in this position by sticking a nail or stick through one of the holes in it. If there is no hole at the required position, one should be made there.

2.3. If a stronger fire is needed or if the fire stops burning well, the chimney damper should be raised as much as is required.

2.4. A **3-holed chulha** with two tunnels has two chimney dampers. When more heat is required in only two holes, the chimney damper next to the third hole should be closed completely. When 3 things are to be cooked at the same time, almost equal heat can be obtained in all three holes by keeping both dampers equally open and adjusted as in 2.2. above.

2.5 A **chulha with hara** also has two chimney dampers. When only the chulha is being used, the hara damper should be kept completely closed. Otherwise, smoke may start coming out of the chulha mouth, especially if the hara is not covered. When only the hara is being used, the chulha chimney damper should be kept closed. When both chulha and hara are being used together, both chimney dampers should be partially opened.



3. Use of front dampers.

3.1. By sliding front dampers in and out, the firebox opening can be made bigger or smaller. By doing this, the amount of air entering the firebox can be regulated. A slow fire requires less air. A fast and strong fire requires more air.

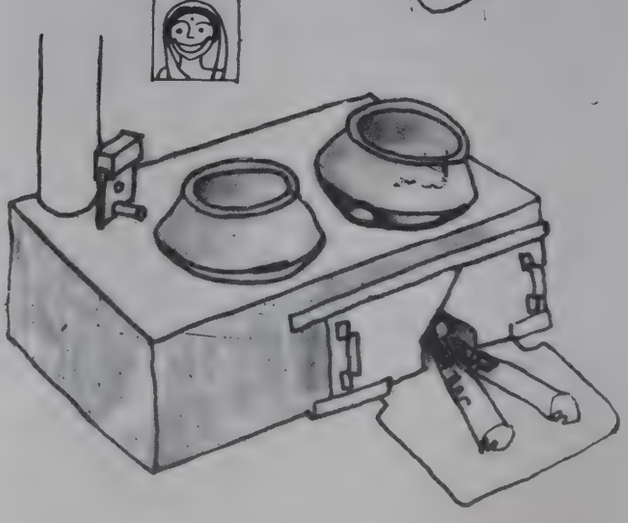
3.2. When lighting a fire, the front dampers should be opened to provide enough air. Once the fire is burning, both dampers should be slid inwards to leave only a small opening for air to come in. In this position the fuel will burn slowly and more completely giving low heat. Closed front dampers also have the advantage of protecting the cook from fire heat during summers.

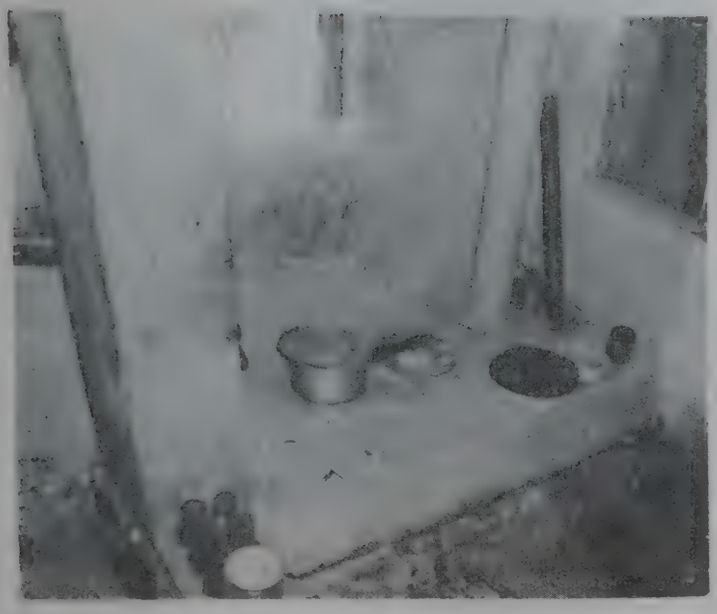
3.3. For a stronger fire, the front dampers should be opened a little more.

3.4. Many users find it difficult to understand the utility of front dampers. To help them understand, the following experiment can be done in their presence.

First a good fire should be started in the chulha with all holes covered. Then a gap should be created between the first hole and the pot above it by placing a pebble in between. The front dampers should be opened completely. Smoke will start leaking out of the gap.

Now the front dampers should be almost completely closed. Despite the gap between pot and hole, almost no smoke will come out. This will be because less cold air entering the firebox will increase its inside temperature. This will make the gases burn better. The same quantity of fuel will be giving more heat.





4. IN BETWEEN OR AFTER COOKING.

4.1. In between cooking meals, all holes should be kept covered and both dampers completely closed. This will

—keep the chulha warm for several hours.

—keep buried fire alive for several hours.

—keep food, milk or water warm for several hours.

—keep ash and sparks inside the chulha.

—make it easier to light the fire next time.

—save fuel by not requiring re-lighting of the fire to warm cooked food.

If any smoke starts coming out of the chulha mouth, the chimney damper should be opened a little.

Proper use of chimney and front dampers will help control power output of the fire, prevent too much heat loss through the chimney or firebox mouth and reduce fuel consumption.

5. COOKING TO SAVE FUEL AND TIME

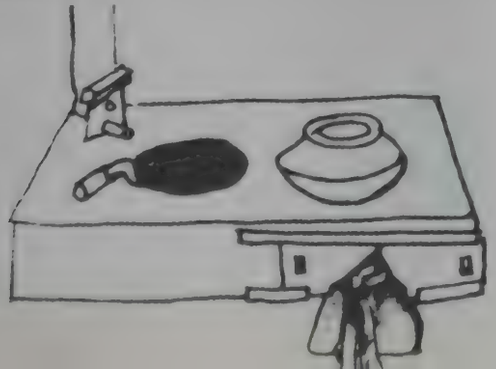
For using the Nada Chulha to best advantage, two or three items should be cooked at the same time. This will save cooking time and fuel.

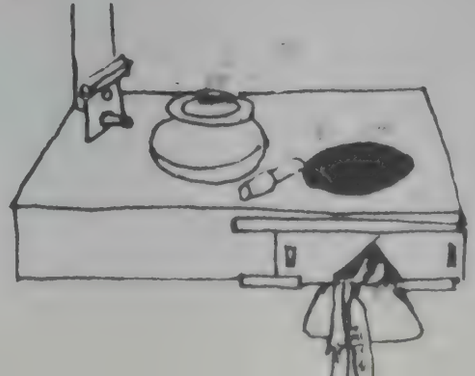
5.1. For cooking roti and vegetable on a two-holed chulha, first the *tava* (iron plate) should be placed on the second hole and the vegetable on the first.

5.2. When the vegetable has started boiling, the pot and tava should be interchanged. This way, by the time the rotis are cooked, even the vegetable will be ready. Rice and vegetable can be cooked together in the same way.

5.3. Some lentils and other food need a long time for cooking. These require a strong fire to bring them to the boil. After that, only enough heat to keep the food at boiling temperature is necessary during the long simmering period. While cooking such items, a lot of fuel can be saved by reducing the power output of the fire after boiling has started. This can be done by almost fully closing both dampers. If there is too much fuel in the fire box, some of this should be removed first.

5.4. When cooking is finished, unburnt fuelwood should be extinguished to avoid wastage.



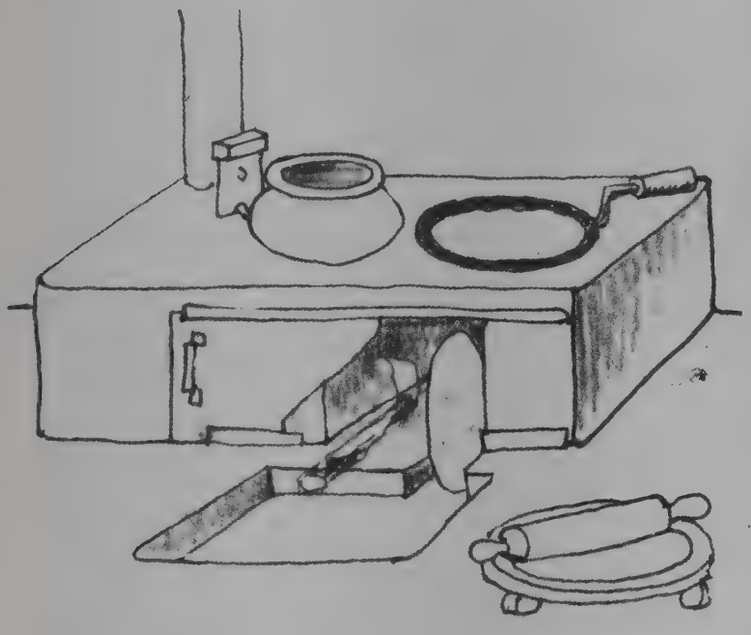


6. ROASTING LARGE ROTIS

Rotis can be cooked on the Nada Chulha as on a gas or kerosene stove or as on a traditional chulha. Any of the following methods can be used:

6.1. For roasting directly on the fire, one side of the front damper can be fully opened and the roti placed vertically against a firebox wall.

6.2. For roasting larger *bajra* or maize rotis, a groove can be dug on one side of the firebox floor and the roti stood in this. When rotis are not being made, this groove should be filled with ash.

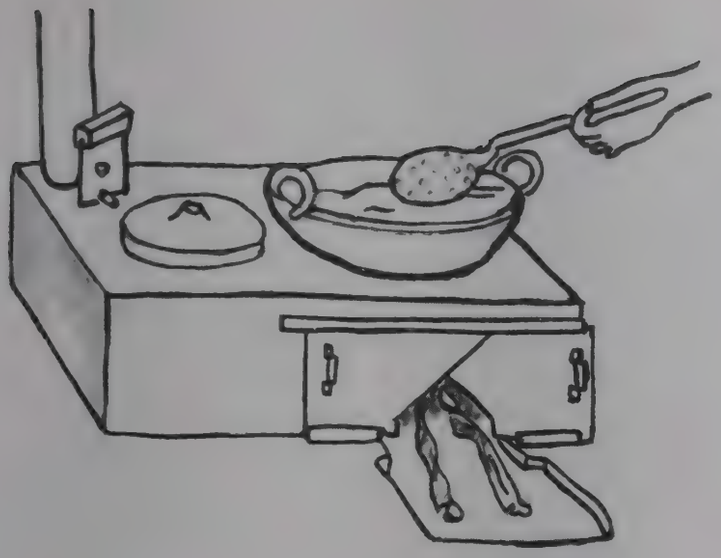


6.3. Or, the height of the firebox mouth can be increased by cutting away some mud from the front edge of the floor and making the floor slope upwards into the firebox.

In no case should the inside height of the firebox be increased. That will increase cooking time and fuel consumption.

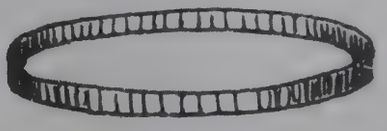
6.4. Rotis can also be roasted on burning charcoal pulled out into the ash pit.

6.5. Rotis can also be cooked directly on the *tava* as on gas or kerosene stoves. When this is done, the front dampers can be kept almost closed.

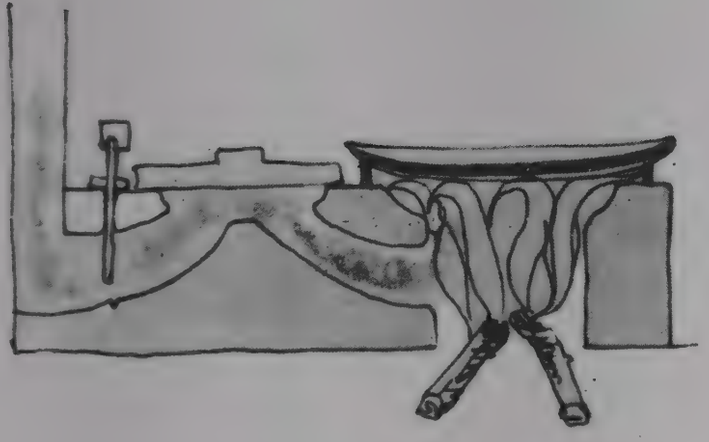


7. OCCASIONAL COOKING WITH LARGE UTENSILS

7.1. The size of cooking holes is fixed by the most used pots in the kitchen. For occasional cooking with a large utensil on the first hole, the second hole can be covered with a flat cover. However, cooking will tend to be slow as only a small area of the utensil will be exposed to fire heat.

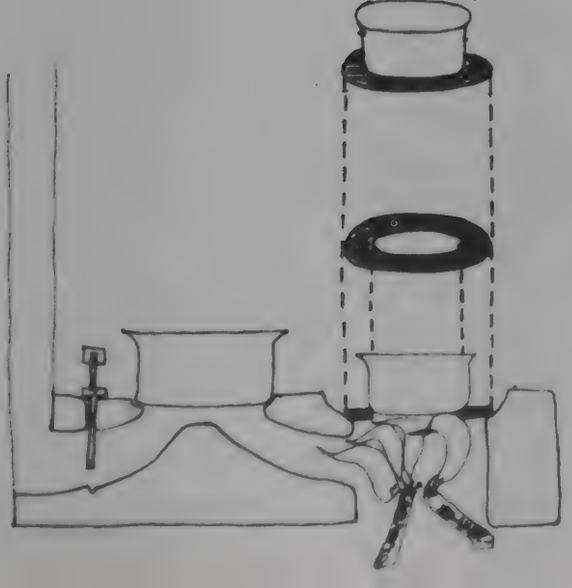


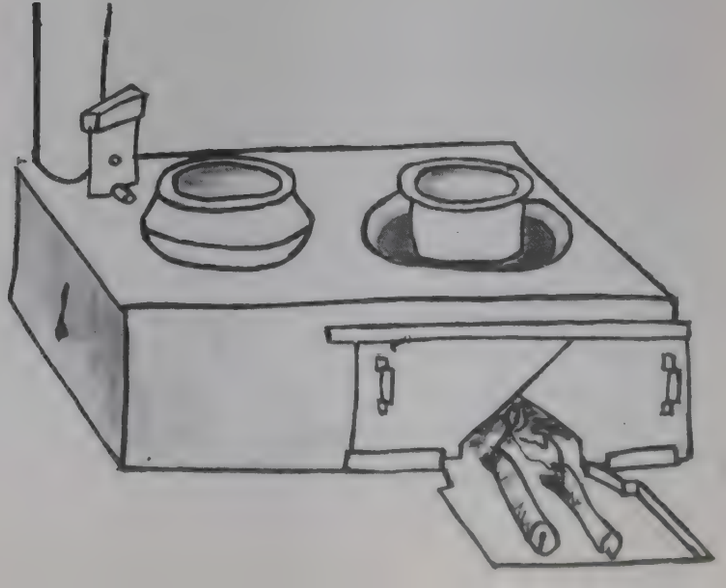
7.2. If an extra large utensil has to be used more frequently, a metal ring of a diameter almost as large as the utensil and 1" to 1½" (25 to 38 mm) high should first be placed around the hole. Placing the large utensil on this will expose more of its area to the fire heat and make cooking faster.



8. OCCASIONAL USE OF EXTRA SMALL POT.

If an extra small pot is used for something like preparing one or two cups of tea, a metal ring should be used to reduce cooking hole size. The ring's outer diameter should be a little bigger than that of the chulha hole. It's inner diameter should be a little smaller than that of the small pot. The ring should sit as far down the cooking hole as possible.





9. WARMING AND HEATING DURING WINTER.

In cold areas, the chulha is also used for keeping the family warm. This can be done with the Nada Chulha in the following ways.

9.1. The chulha is used like a traditional chulha for the purpose. With the chimney damper closed and all holes open, the family can sit around the fire as before. But this will result in the room or kitchen getting filled with smoke.

9.2. If no smoke is wanted, all cooking holes should be covered, the chimney damper left a little open and burning fuel pulled closer to firebox mouth. Burning charcoal can be pulled out into the ashpit and the family can sit around the chulha as usual.

9.3. In very cold areas, where heating rooms is also necessary, only metal chimneys and metal covers for holes should be used. Metal radiates more heat into the space around it.

SECTION II

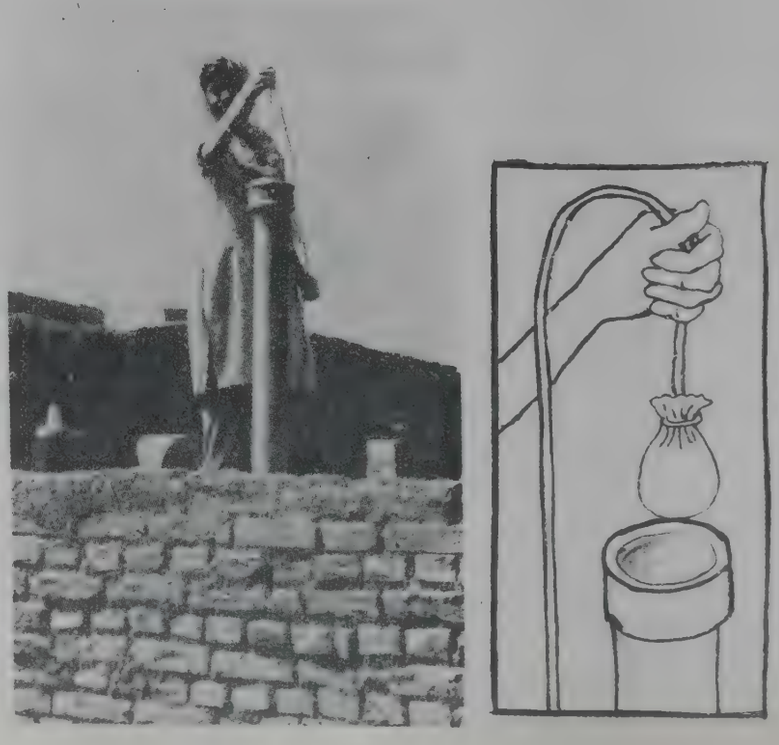
10. CLEANING THE CHIMNEY.

10.1. The chimney requires cleaning from time to time. The frequency can be from once a fortnight to once every two or three months. This depends on how much a chulha is used and the types of fuels burnt.

10.2. The easiest method of cleaning a chimney is to first tie up some sand or earth in a waste cloth piece. The sand bag should be small enough to go inside the chimney and tied to a piece of string longer than full chimney height.

After closing the chimney damper and lifting the cowl, the bag should be lowered into the chimney and pulled up and down a number of times.

The fallen soot can be removed through the cooking hole nearest to the chimney by hand or with a *karchi*.



10.3. The chimney can also be cleaned by tying a brush or a piece of cloth to the end of a long pole and moving this up and down the chimney a number of times. This method might be necessary where soot or creosote has got stuck on chimney walls and requires forceful scraping.

But care is needed! If the cloth or brush is not tied firmly to the pole, it might get stuck inside the chimney.

Or, if the pole is not long enough, it might slip from the hand and fall inside the chimney. The chimney will have to be removed to remove the pole!

10.4. To make it possible to clean the chimney, the cowl **must not** be fixed to the chimney. It should be removable.

Cleaning the chimney from time to time is necessary for the chulha to work properly and for smoke to go out.

COMMUNITY HEALTH CELL

11. CHIMNEYS AND FIRE HAZARD.

The Nada Chulha is much safer than traditional chulhas against burn accidents and fire hazards. However, care must be taken in some respects.

11.1. Where the chimney passes through a thatched roof, a thick layer of mud **must** be provided between chimney and thatch. And, the cowl must always be kept in position to prevent sparks coming out of the chimney falling on the thatch. This has already been discussed in chapter IV. But it is extremely important that chulha owners with thatch roofed kitchens understand the danger and take necessary precautions.

11.2. In cold climates, or where the main fuel burnt is animal dung, creosote-like deposits might form inside the chimney. These can sometimes catch fire and burn at very high temperatures. Frequent scraping and cleaning of the chimney is a **must** in such cases.

12. REGULAR MAINTENANCE AND CHULHA DURABILITY

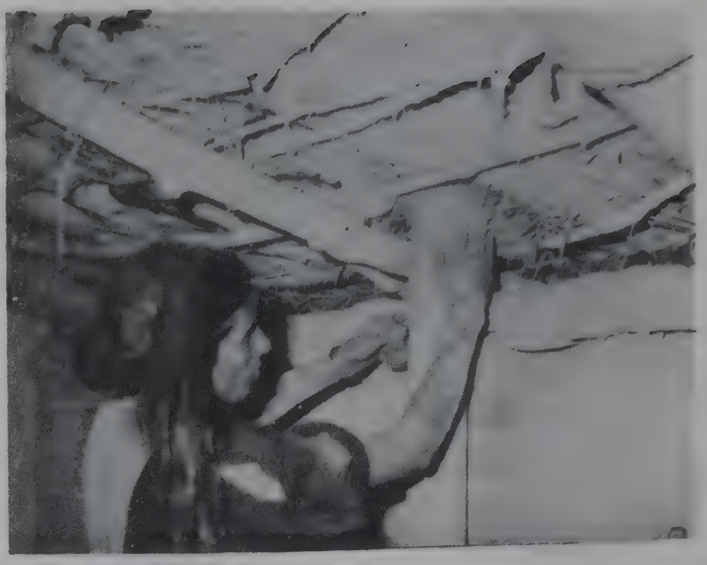
A mud chulha can last for many years, if a few simple rules are followed.

12.1. Before being put to use, a new chulha should be allowed to dry out completely. This will prevent it from cracking and make it stronger.

12.2 Frequent washes of a thin clay and water mix will keep filling small cracks as and when they appear. They will not develop into big ones

12.3. In some areas, these regular washes are given with a clay and dung mixture. This is thicker than a simple clay and water wash. With time, chulha height increases and cooking holes become smaller. Both make the chulha work badly. If possible, users should be asked not to give dung and clay washes. However, if they still do, they should be asked to scrape off the collected layers from chulha top and edges of holes every month or so.

Cooking holes should be kept as big as possible and internal height of the firebox should not be increased.



Stuffing gara between chimney and thatch roof.

Applying a thin mud and clay wash to the chulha.

Scraping off collected layers of dung and clay from edges of cooking holes.

13. DOING SMALL REPAIRS.

13.1 Too much wear and tear makes it necessary to rapair the chulha from time to time. In a well built chulha, only two or three points require this. These are the bridge over the firebox opening, edges of first cooking hole and inner walls of the firebox. These should be repaired quickly to not let them grow.

13.2. The following general rules should be followed while repairing a chulha:

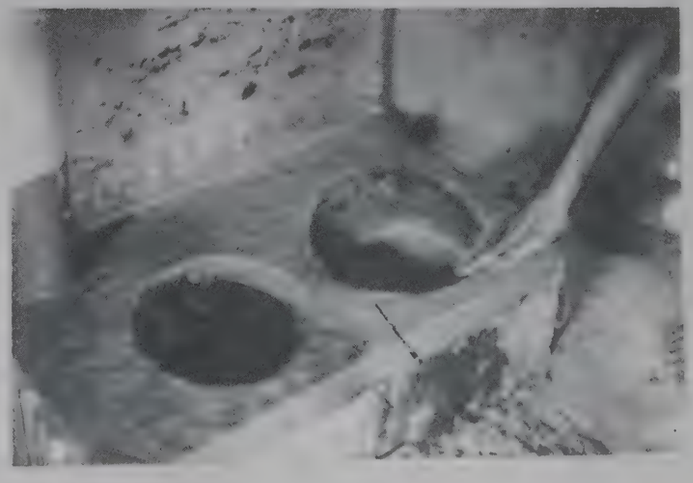
The chulha should be allowed to cool completely. Fresh gara applied on a hot chulha will fall off quickly.

Water should be sprinkled on the surface to be repaired **before** fresh gara is applied. This will make the joint between the old and new gara stronger.

If the surface around a crack is smooth and flat, some grooves should be dug in it to provide a better grip for the new gara.

Gara for small repairs should be quite thin. The required thickness can be built up by applying many layers.

Burnt clay about to fall off from firebox walls should be removed completely and replaced with fresh gara.



13.3. While repairing the inner walls of the firebox, the width, depth and height of the firebox should not be increased. The width and depth of the firebox should **never** be more than the diameter of the cooking hole above it.

13 4 While repairing cooking holes, their diameters should not be made smaller.

Repairs carried out in time will increase the life of the chulha to several years.

Chapter 7

COMMON PROBLEMS AND THEIR SOLUTION

This chapter should be used towards the end of a course to help trainees deal with common problems of users. Much of its content has already been covered in earlier chapters. However, it is presented here to help trainees see how theory relates to practical problems. When they start working as mistris, they will have to deal with many reactions from users. The three groups of common problems described here are based on a lot of feedback collected on users' complaints. Many of them are not due to wrong construction. They are because users do not understand how to use and maintain the chulha properly. This makes clear the importance of educating users while spreading the improved chulha.

Just as the training of mistris needs to be based on practical work, users' education requires maximum practical demonstration. When a new chulha is built, the user is told how to use and maintain it. However, many women understand only a part of this. Only after they have had a chance to use their chulhas do they start asking questions or posing problems.

The best way of introducing this chapter during a course is through role play. Two or three experienced mistris or supervisors can act out the roles of an unhappy chulha owner and the mistri trying to understand the cause of her complaints. Trainees can then be asked riddles about what might be causing different problems. Anything not covered by role play and riddles can be discussed by the trainer in the end.

Role play on commong problems.

This should be followed by a field visit to a number of chulhas already in use. Groups of 3 to 4 trainees should visit a few working chulhas and talk to their owners. Wherever a problem is found, they should be asked to solve it. Finding construction mistakes and seeing users' reactions to chulhas that do not function properly will also make the trainees build chulhas with more care.

A trainee making a cooking hole bigger.

INTRODUCTION

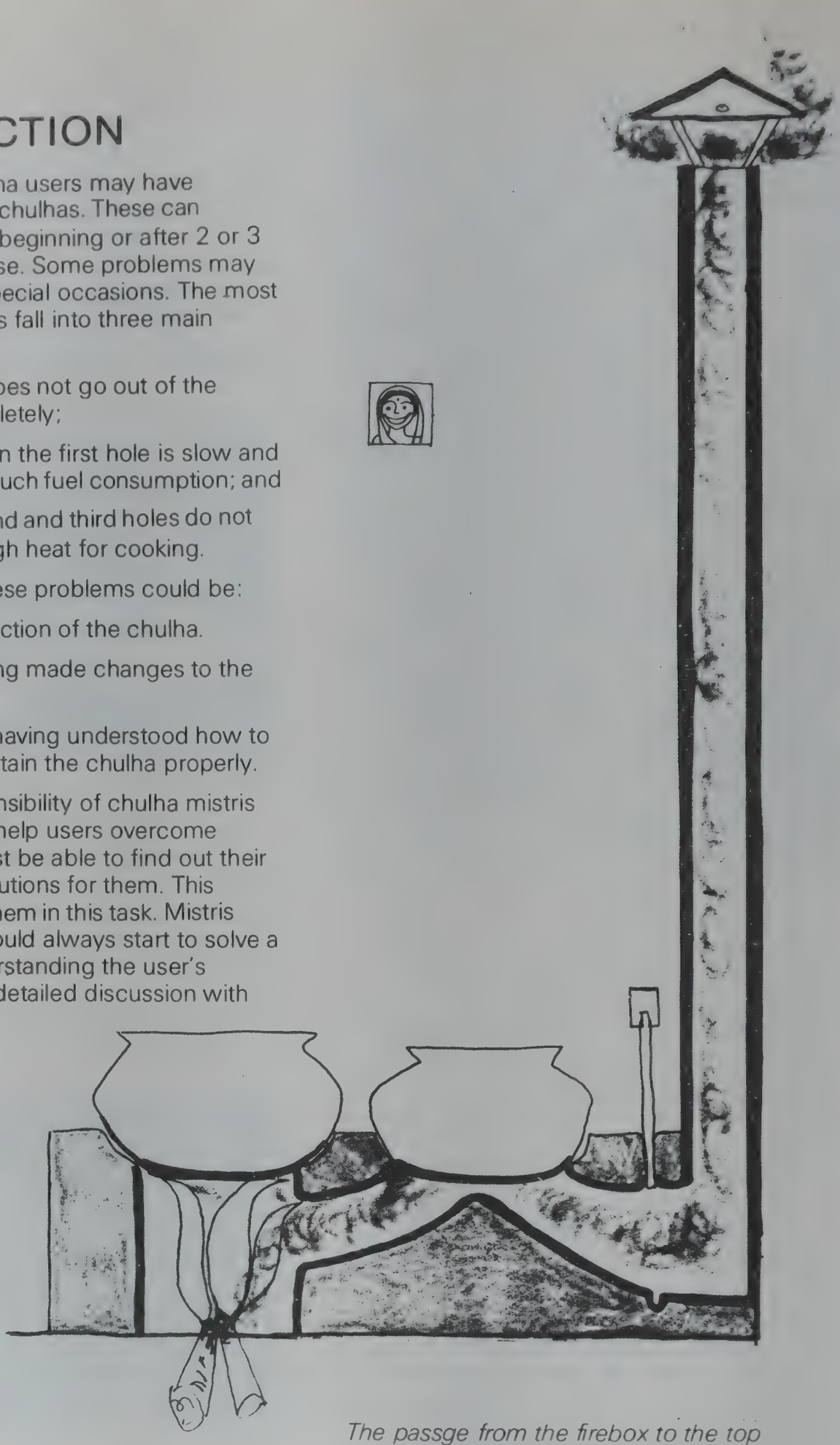
Some Nada Chulha users may have problems with their chulhas. These can happen right in the beginning or after 2 or 3 months of chulha use. Some problems may come up only on special occasions. The most common complaints fall into three main groups:

1. that smoke does not go out of the kitchen completely;
2. that cooking in the first hole is slow and there is too much fuel consumption; and
3. that the second and third holes do not receive enough heat for cooking.

The causes of these problems could be:

1. faulty construction of the chulha.
2. the user having made changes to the chulha, or
3. the user not having understood how to use and maintain the chulha properly.

As it is the responsibility of chulha mistris and supervisors to help users overcome problems, they must be able to find out their causes and find solutions for them. This chapter will guide them in this task. Mistris and supervisors should always start to solve a problem after understanding the user's complaint through detailed discussion with the user.



The passge from the firebox to the top of the chimney should have no obstruction.

1. INCOMPLETE SMOKE REMOVAL

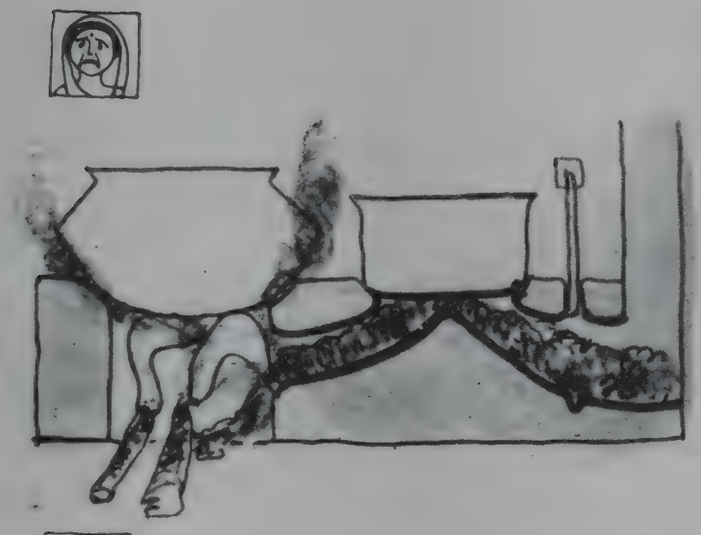
If all the smoke is not going away through the chimney, the reasons could be:

1. some obstruction in the passage from the firebox to the chimney outlet;
2. too much flow resistance in the chulha compared to chimney draft;
3. wrong size or location of chimney, and,
4. smoke leakage from other points.

Each of these is discussed below.

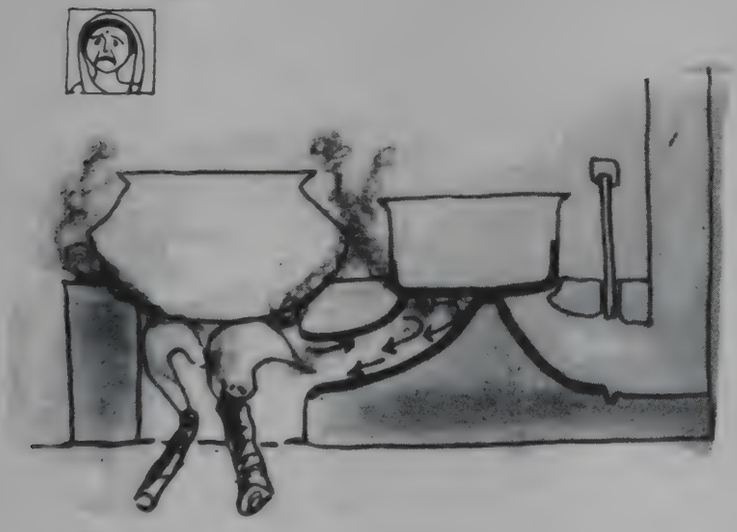
1.1 Obstructions in the path of smoke

The passage for smoke must be clear all the way from the firebox to the top of the chimney. To find out if there is any obstruction, a quick examination of the following points should be made:



a. Tunnel clogged with ashes

If removing ashes from the tunnel solves the problem, users will have to be explained how important it is that they remove ashes regularly.



b. Baffle touches pan bottom

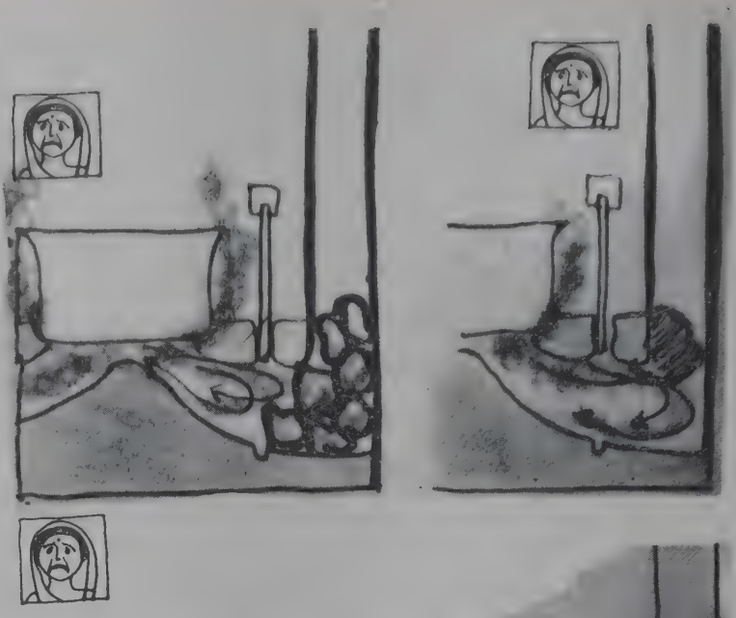
This can be checked by placing a small ball of dough or gara on the top of the baffle, pressing a pot firmly on the cooking hole and removing it. The squashed thickness of the ball will show the gap between pot and baffle, if any.

If the baffle is too high, some clay should be scraped off the top to leave a gap of ¾" (20 mm) to 1" (25 mm) between pot bottom and baffle.

c. Outlet to chimney blocked.

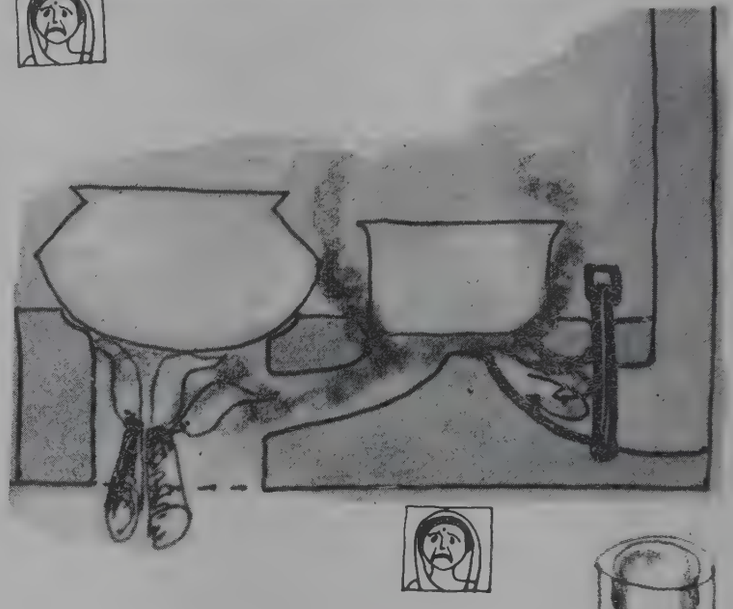
This can be checked by moving one's hand around the joint of the chimney and tunnel. Sometimes, tin chimneys supported on top of chulhas get pushed down while the gara is still wet. This results in the outlet to the chimney getting blocked or becoming too

small. At other times, some gara might have got stuck inside the chimney during construction. Sometimes children throw stones inside the chimney. The passage should be cleared either by lifting the tin chimney or by removing the gara or stones blocking the passage.



d. Chimney damper completely closed.

Some users have complained of strong backflow of smoke. On closer examination, it has been found that they leave the chimney damper completely closed. Proper use of the damper must be demonstrated and explained to them.

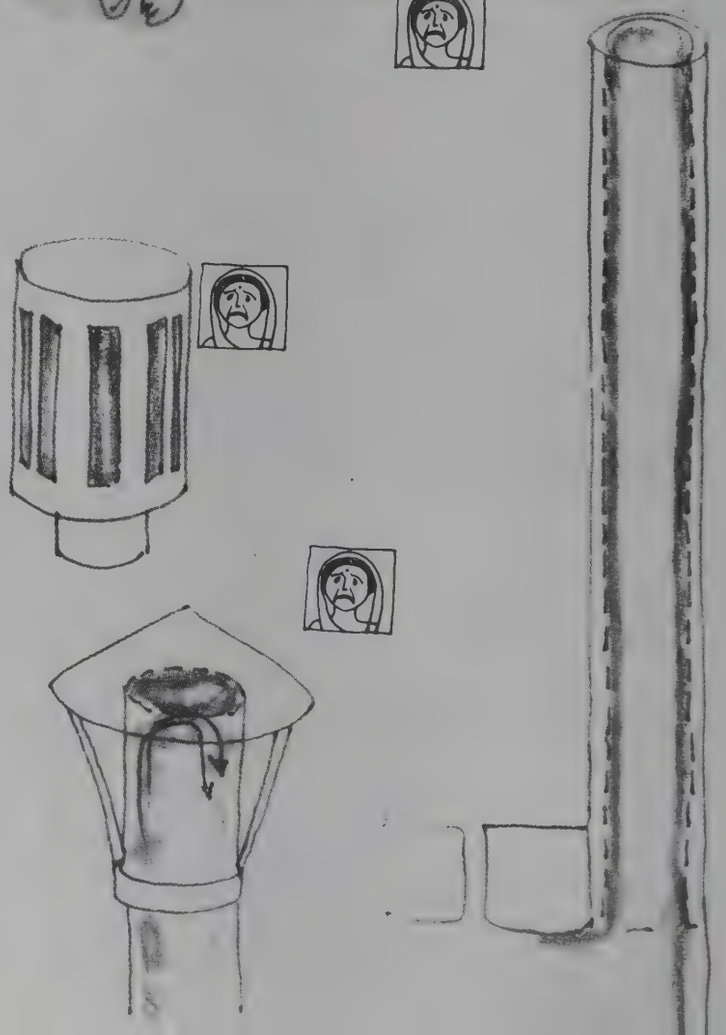


e. Chimney clogged with soot.

Some users do not understand the importance of cleaning the chimney from time to time till their chulha stops working properly due to the chimney getting clogged with soot. Demonstration of chimney cleaning is the best method of helping users understand how important it is.

f. Side openings of cowl clogged

Some cowls, especially asbestos cement or pottery ones, have only small openings for smoke to go out. These can get blocked with soot in a few weeks, resulting in smoke backflow. Users have to be explained the importance of keeping cowl openings clear. If these keep getting blocked too quickly, it will be better to use a cowl with bigger openings.

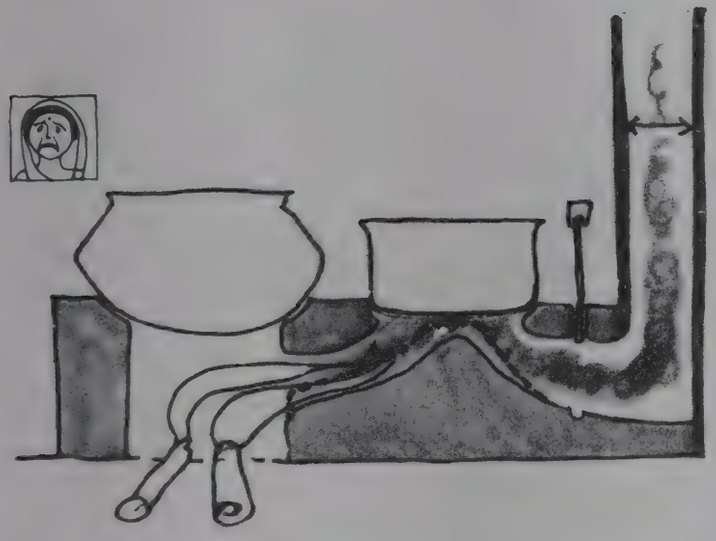


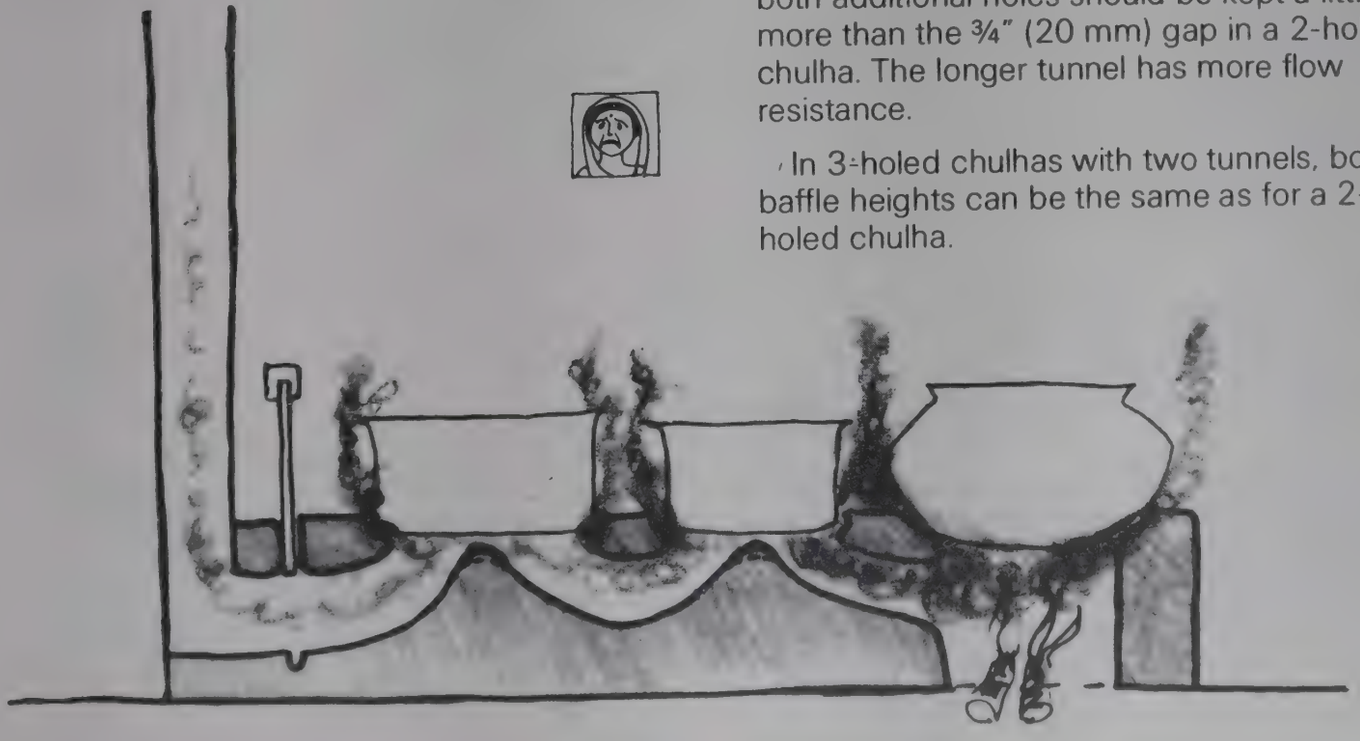
g. Wrong placing of cowl

Some users do not understand that the cowl must be fitted in a way that smoke can escape from its side openings. If the cowl is pushed so far down as to leave no side openings, smoke will not be able to escape through the chimney!

1.2. Too much flow resistance in passage

Smoke is pulled out of the chulha with the help of chimney draft. However, to make sure that more heat is given to pots before hot gases and smoke leave through the chimney, obstructions like baffles and bends are provided in the tunnel. (refer chapter III).





These give some resistance to the flow of hot gases and smoke. For a chulha to work properly, the chimney draft (or pull) must be balanced against the flow resistance in the passage. If the flow resistance is too much compared to the draft, the chimney is not able to pull the smoke out completely. The common causes of too much flow resistance are:

a. Tunnel diameter too small

If the tunnel diameter of a chulha is too small in relation to the height and diameter of its chimney, it can produce too much flow resistance in the passage. A rough guide to tunnel diameters for different chulhas is given in chapter IV, section II.

With a little experience, chulha mistris and supervisors will get a good idea of suitable tunnel diameters for different chulha and chimney sizes. The tunnel diameter can be made bigger by scraping off some clay from the sides.

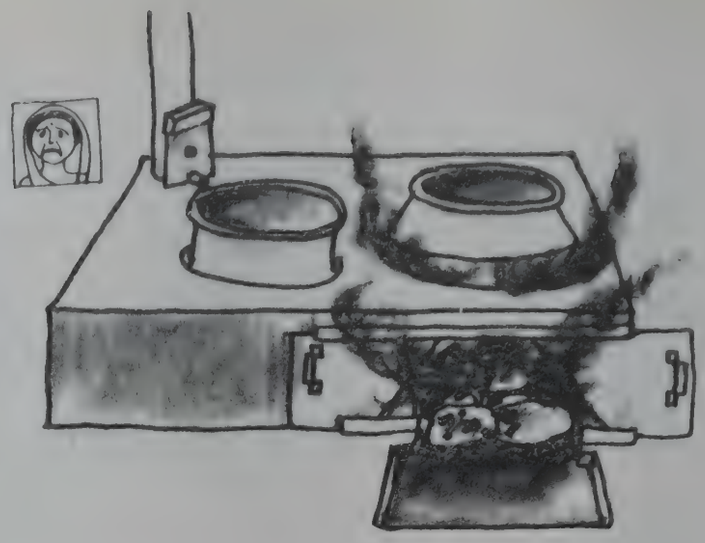
b. Baffle too high

If the gap between the baffle and pot bottom is too small, backflow of smoke will result, especially when a slow fire is burning. In such cases, the baffle should be lowered a little. In a 3-holed chulha with a single tunnel, the gap between baffles and pot bottoms for both additional holes should be kept a little more than the ¾" (20 mm) gap in a 2-holed chulha. The longer tunnel has more flow resistance.

In 3-holed chulhas with two tunnels, both baffle heights can be the same as for a 2-holed chulha.

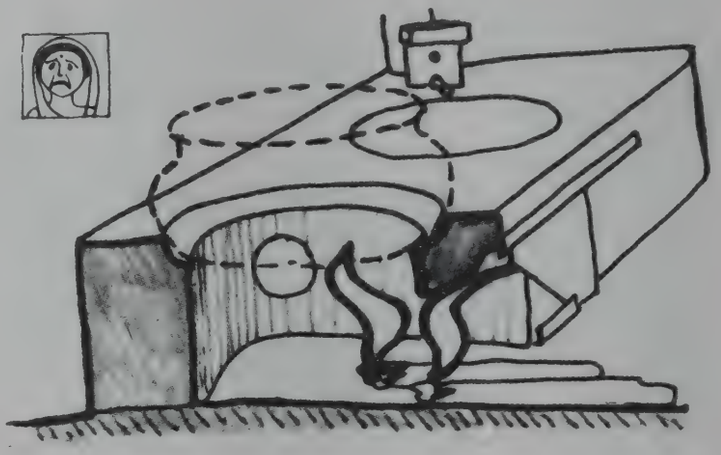
9. Front dampers fully open with slow fire in chulha.

If the front dampers are fully open in a chulha with only a slow fire, there might be some backflow of smoke. This is more likely if the fuel is near the chulha mouth and consists of dung cakes. Users need to be shown how this can be stopped by closing the front dampers and pushing the fuel inside the firebox.



d. Wrong shape of firebox bridge ceiling

If the ceiling of the bridge over the firebox slopes upwards towards the front of the chulha, it can result in some smoke and flames coming out of the chulha mouth. This is more likely when the fuel has been pulled outwards for roasting rotis. The ceiling of the roof should be sloped upwards towards the cooking hole to stop this.



1.3. Wrong size or location of chimney.

a. Chimney diameter too small

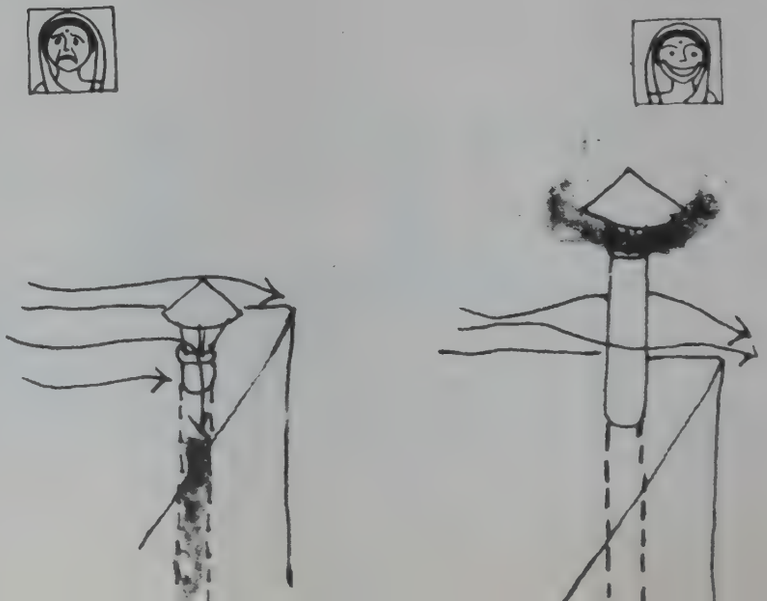
For most 2-holed chulhas in the plains, a 3 inch (75 mm) diameter chimney is enough. For 3-holed chulhas or for chulhas with haras a 4 inches (100 mm) diameter chimney is better. In high mountainous areas, chimney diameter should not be less than 4 inches (100 mm).

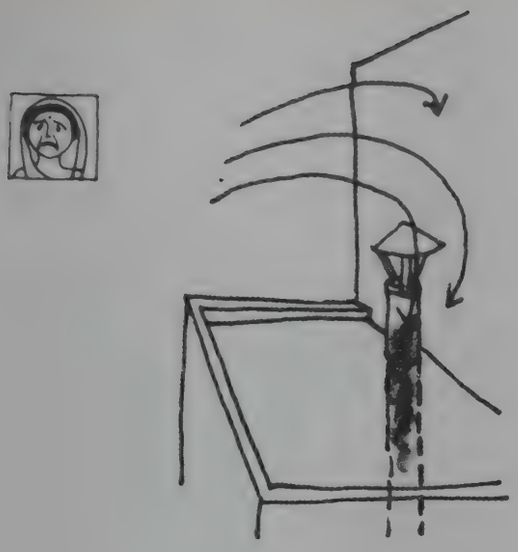
If the chimney diameter is too small for the size of the chulha, some smoke might come back. A chimney with a bigger diameter might have to be used.

The diameters given here apply only to family size chulhas. For bigger institutional chulhas, bigger diameters will be required.

b. Chimney not tall enough

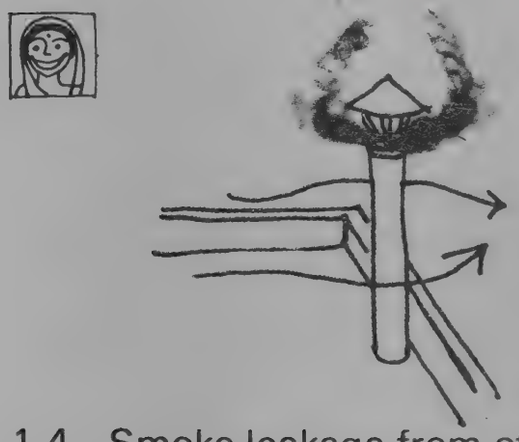
If the chimney ends only a few inches above the roof, backflow of smoke can result on windy days due to backdraft. The chimney length should be increased to finish at least 2 feet (600 mm)above the roof.

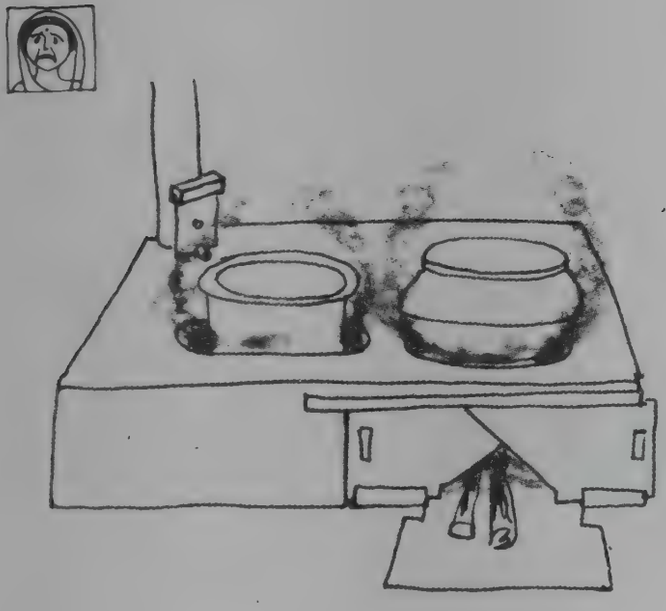




c. Chimney outlet next to a high wall.

If there is a high wall next to where the chimney comes out of the roof, there can be strong backflow of smoke on windy days. The height of the chimney should be increased to to 2 feet (600 mm) above the high wall. Or, the location of the chulha should be changed so that the chimney outlet has no high obstruction around it.





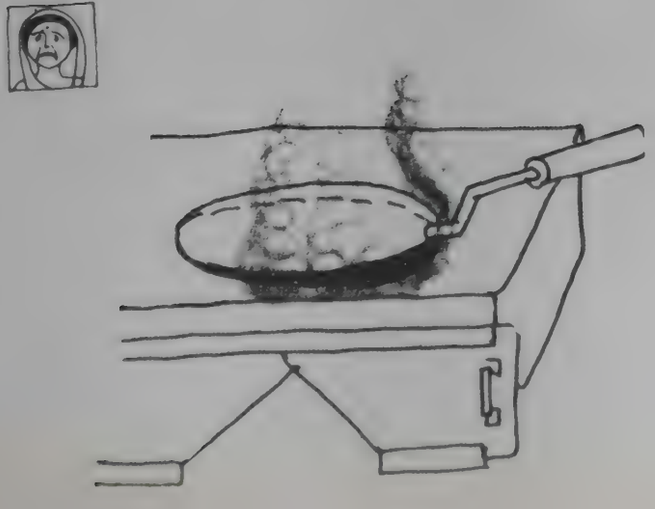
1.4. Smoke leakage from other points.

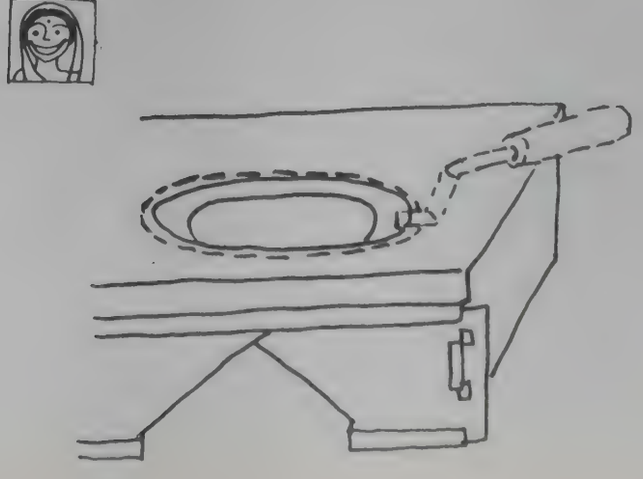
a. Pots not fitting holes properly.

Wrong shaping of cooking holes can result in smoke leaks through gaps between pots and holes. The gaps should be filled with thin gara.

b. Tava with handle used.

Handles of tavas raise the tava above the chulha surface at the point where the tava and handle are joined. Smoke leaks out from the tava sides when such tavas are used. The way out of this problem is to make a notch on the chulha top at the most convenient location for the hara handle so that the whole tava rests flat on the chulha.





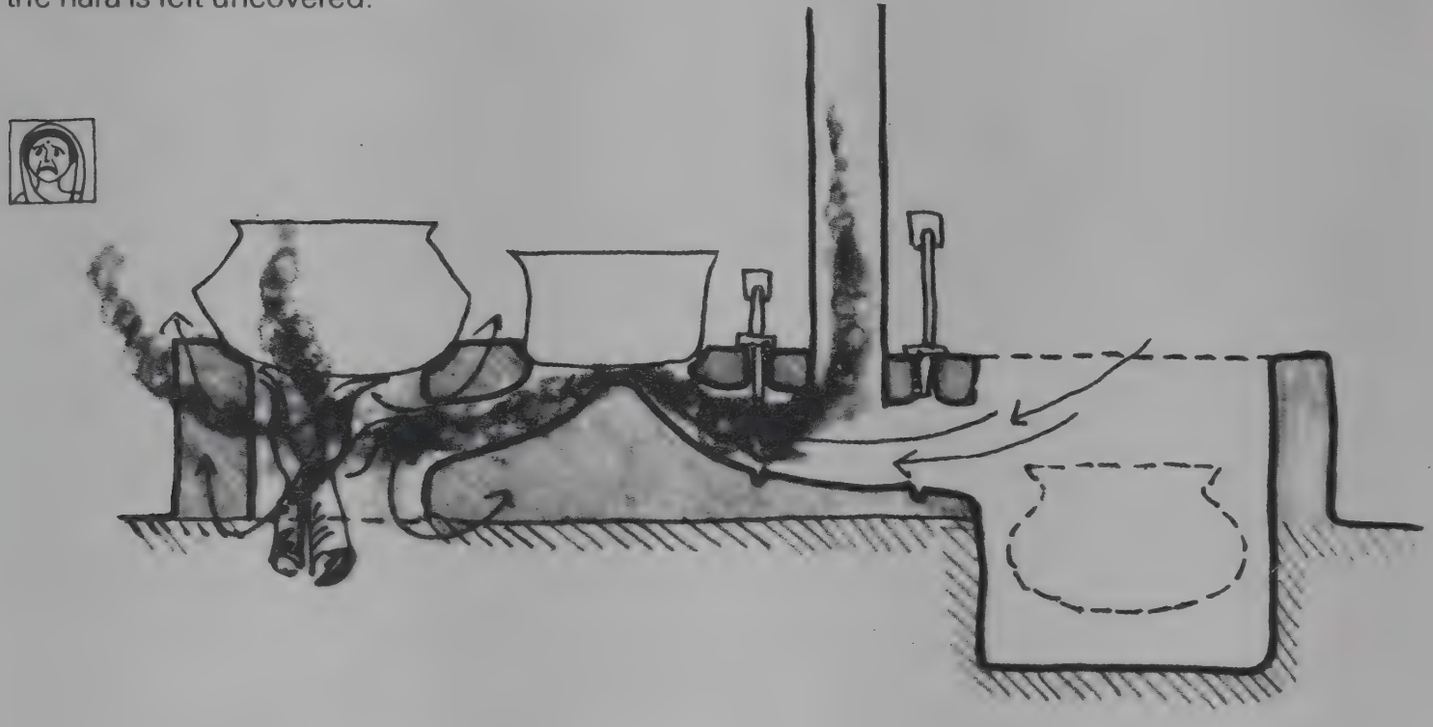
c. Smoke from fuel outside firebox

Many villagers use long pieces of fuelwood and/or agricultural residues. While one end of the fuel is burning inside the chulha, the other end is sticking out in the front. If the fuel is wet, the parts sticking out produce smoke.

There is no solution for this, especially in the roti roasting areas, other than cutting fuel pieces to shorter lengths. In non-roti roasting areas where easy access to the fire is not so important, the problem can be solved by making the bridge over the firebox mouth wider.

d. Chimney damper of hara left open.

If a hara attached to a chulha is not being used while the chulha is, the chimney damper of the hara should be kept completely closed. Otherwise backflow of smoke may result when the hara is left uncovered.

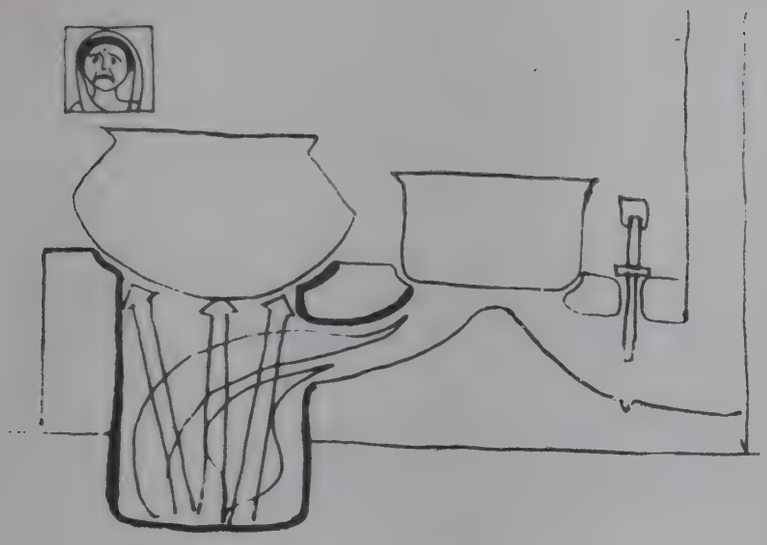


2. LOW HEAT IN FIRST HOLE AND/OR TOO MUCH FUEL CONSUMPTION.

Although, the vast majority of Nada chulha users report faster cooking and much reduced fuel consumption, it happens that some users complain of the opposite. Users of about 5 percent Nada Chulhas built so far have complained of slow cooking in the first hole, and too much fuel consumption. The common causes for this complaint are:

1. not enough heat reaching the pot.
2. the fuel not burning fully, and,
3. miscellaneous.

These are discussed below.

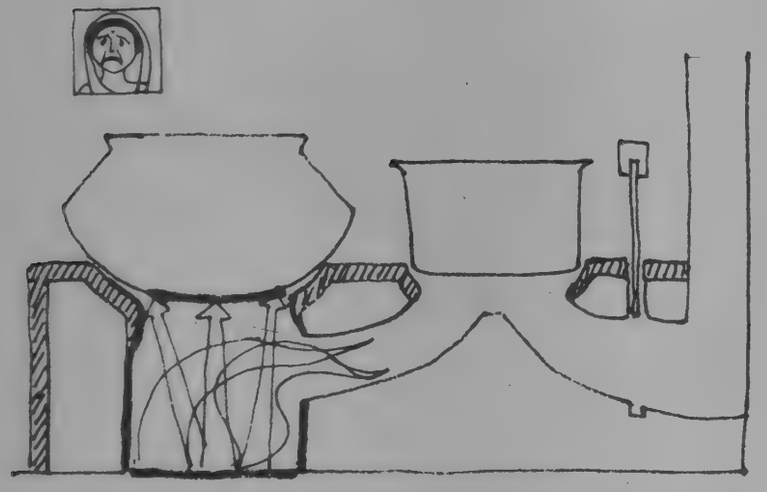


2.1. Not Enough Heat Reaching Pot

This can be due to any of the following:

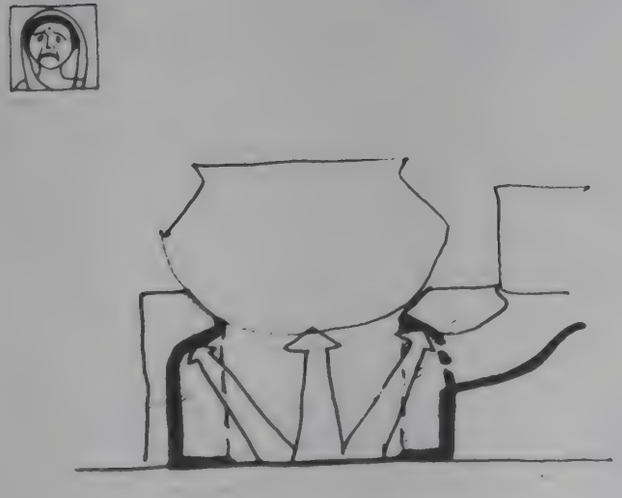
a. Height of firebox too much

The distance between firebox floor and the bottom of the pan placed above is one of the most important dimensions for making sure that enough heat from the fire reaches the pot. Best firebox heights for different fuels have been given in chapter IV, section IV. Distances more than these will cause slow cooking and too much fuel consumption. Where traditional chulhas are 10" (250 mm) to 12" (300 mm) high, women users often increase the internal firebox height of even the Nada Chulha by digging the firebox floor. This problem can come up in such cases. The women have to be asked not to do this and explained why.



Sometimes this complaint is received for chulhas which were working well for 2 to 3 months. This happens where women give the chulha regular washes with a dung and clay slurry. Collected layers of this on the chulha top increase the internal height of the firebox. Even the diameters of cooking holes become smaller which makes the problem worse. Such users have to be explained that they must remove the collected layers from chulha top and hole edges from time to time.

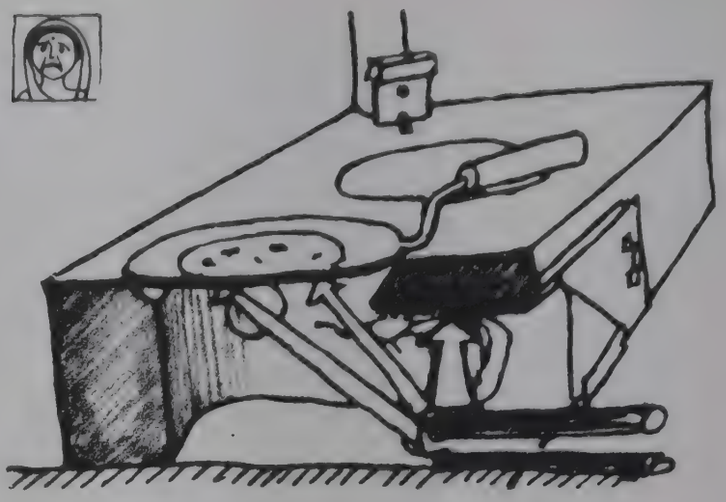
b. Width and depth of firebox too much



If these are more than the diameter of the cooking hole above the firebox, too much fuel consumption can result due to much of the fire's heat going to the roof of the chulha. This can happen either because the chulha was not built properly or with wear and tear over time. If it is due to too much use, users must be explained that it is important to replace fallen gara from inside firebox walls from time to time.

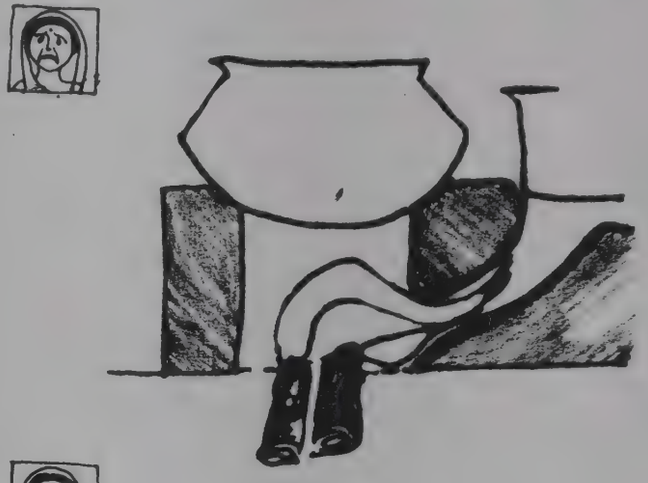
c. ***Width of roof over firebox too much***

This can cause slow cooking in the first hole only when rotis are roasted in the firebox mouth. When this is being done, the burning fuel is pulled out near the chulha front. However, due to the width of the firebox roof being too much, most of the fire heat goes to the roof instead of the tava. The solution to this problem is to reduce the roof width to about 3 inches (75 mm).



d. ***Tunnel mouth located near firebox floor.***

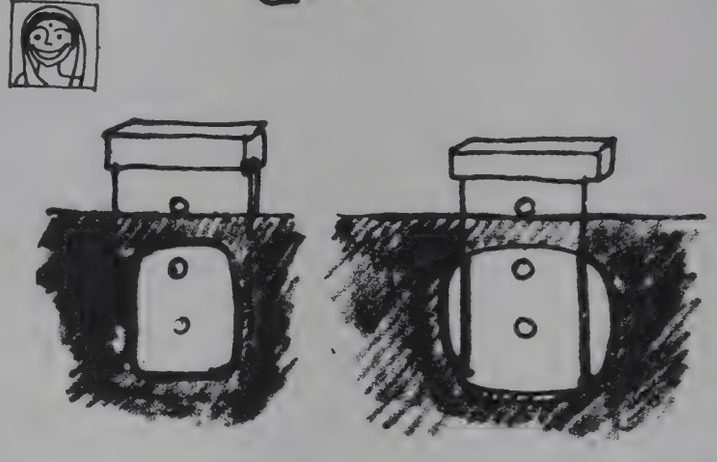
If the tunnel leaves the firebox from near the floor and the chimney draft is too strong, the flames will get pulled away before touching the pot bottom. This will result in slow cooking and too much fuel consumption. The mouth of the tunnel should be raised to start 3" (75 mm) above the firebox floor.



e. ***Chimney damper not used or ineffective***

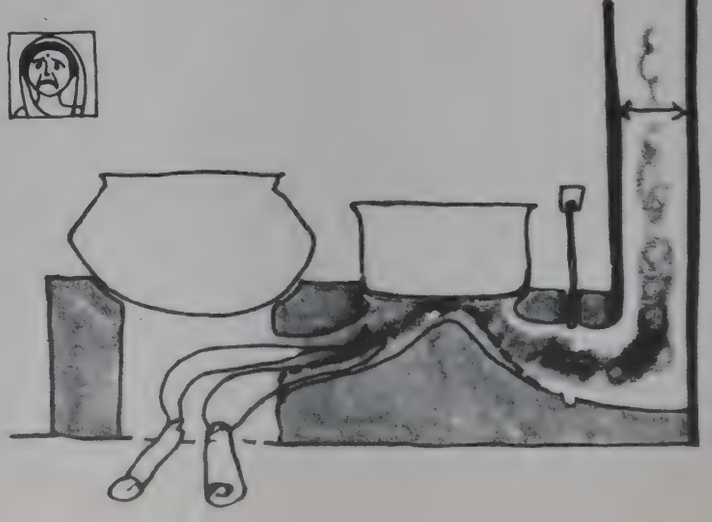
If the chimney damper is left fully open all the time and the chimney draft is strong, the first pot will receive less heat due to the horizontal pull on the flames. The user must be explained how to use the chimney damper and why.

It should also be checked if closing the damper results in complete blocking of the tunnel or not. Gaps on the sides or under the closed damper may be found. These gaps will have to be filled.



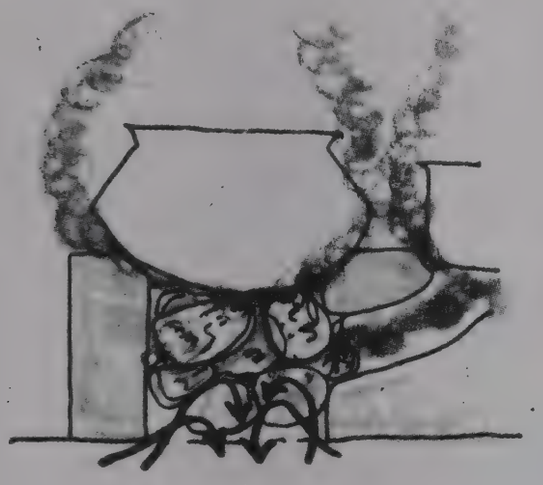
f. ***Chimney diameter and height too much***

Sometimes, the structure of the house makes it necessary to use very tall chimneys. Or, very small chulhas are fitted with 4" (100 mm) diameter chimneys. The more the height or diameter of the chimney, the more is the draft. Too much draft will increase fuel consumption or make cooking slow. The draft can be made less by reducing the tunnel diameter and raising the baffles a little.



2.2. Incomplete burning

Slow cooking and too much fuel consumption can also result from incomplete burning of the fuel. This can be caused by too little air supply to the fire. If this is the case, you do not get as much heat out of the fuel as is possible.



a. Chimney clogged with soot

The most common cause of incomplete burning is a clogged chimney. Due to less draft, the fuel does not get enough oxygen for burning properly.

b. Height of firebox too small

When the height of the firebox is too small, the hot gases do not mix with the air and therefore cannot burn properly. Due to the fixed chaapri height of the Nada Chulha, this does not happen much. However, some users fill the firebox with too much fuel or do not remove the ashes for many days. Both make it difficult for the fuel to get enough air to burn properly.

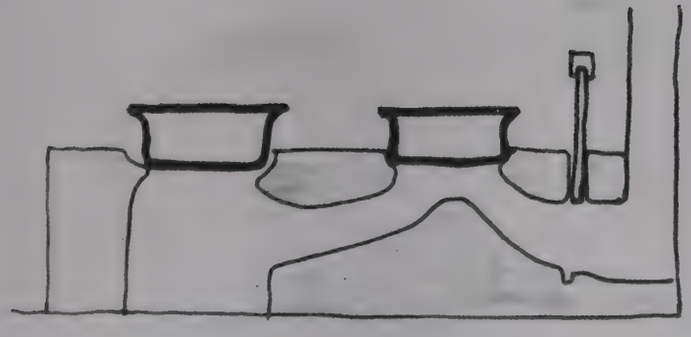
2.3. Miscellaneous Causes.

a. Chulha still wet.

In cold climate or during winters, it can take a few days of use before the chulha becomes completely dry from inside. Problems of slow cooking and too much fuel consumption are likely during these first few days. If no other reason can be found, it is best to ask the user to wait till the chulha is completely dry.

b. Short duration cooking on a big chulha

Sometimes, the problem of slow cooking and too much fuel consumption is there but no easy reason can be found for it. It may be that the family uses the chulha for short periods only twice in the day and has only 3 or 4 members needing small pots. However, while getting their chulha built, they had shown large pots used once in a while. As a result, their chulha is too big for their needs. Such chulhas take longer to heat up because a lot of heat goes into heating the body of the chulha. By the time the chulha has heated up, the family's cooking is over. The heat absorbed by the chulha body is lost because by the time the next meal is cooked, the chulha is cold again.

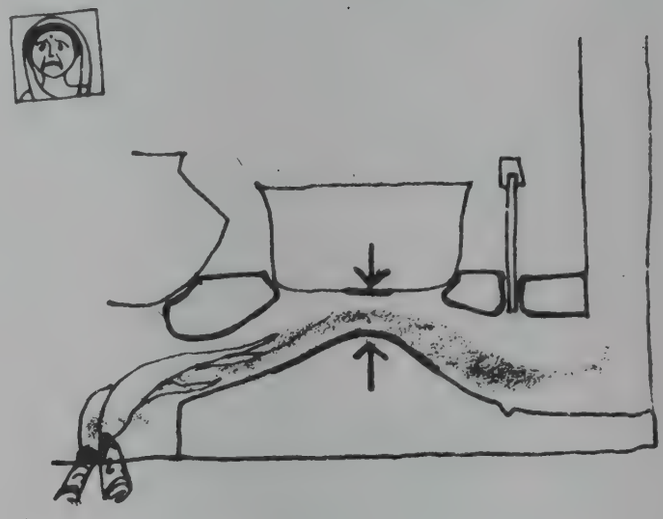


In such cases, the solution is to rebuild the chulha to a smaller size. The spaces where dry earth is normally filled should also be left hollow. Such chulhas will heat up much faster and fuel consumption will become less.

3. SLOW COOKING IN SECOND COOKING HOLE.

In most cases, the cooking hole next to the firebox should receive enough heat for cooking. However, some users complain that this does not happen. This can be due to:

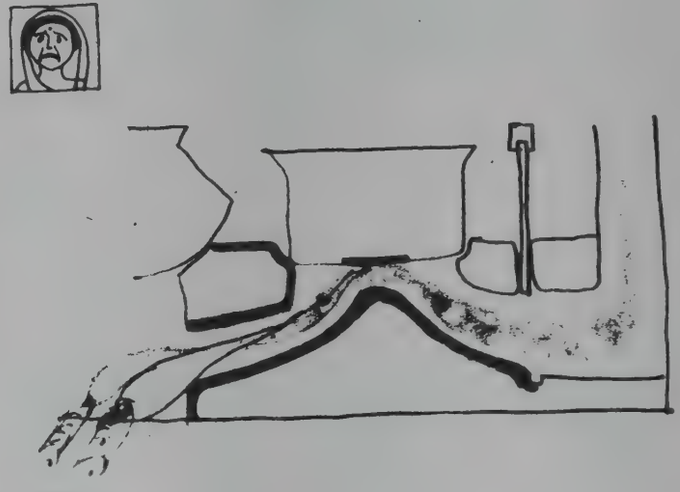
1. enough heat not going into the pot, and,
2. the gases having cooled down by the time they reach the second hole.



3.1. Not Enough Heat Going To Pots.

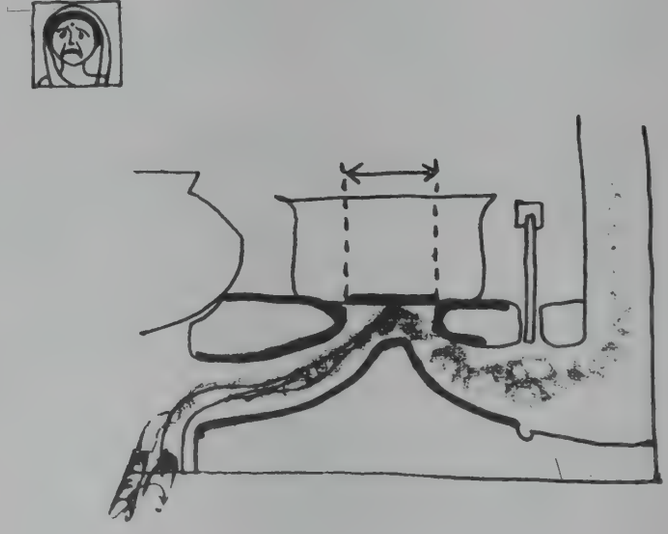
a. Baffle too low.

If the gap between the baffle and the bottom of the pot is more than 1" (25 mm), not enough heat will go to the pot. The top of the baffle should be raised.



b. Tunnel roof too thick

At the points where the tunnel roof meets the second or third hole. Its thickness should be only ½" to ¾" (12 - 18 mm). More thickness will reduce the heat reaching the pots by keeping the hot gases and flames too far away. Where this is found, some clay should be scraped off the tunnel ceiling.



c. Cooking hole diameter too small

Cooking hole diameters should be as large as possible for the most used pots. Due to being used to small hole sizes in traditional chulhas, some women reduce the holes of even Nada Chulhas. Sometimes, they do this for reasons of looks. They must be explained why they should keep holes big and hole diameters of their chulhas should be increased by scraping off some clay from hole edges.

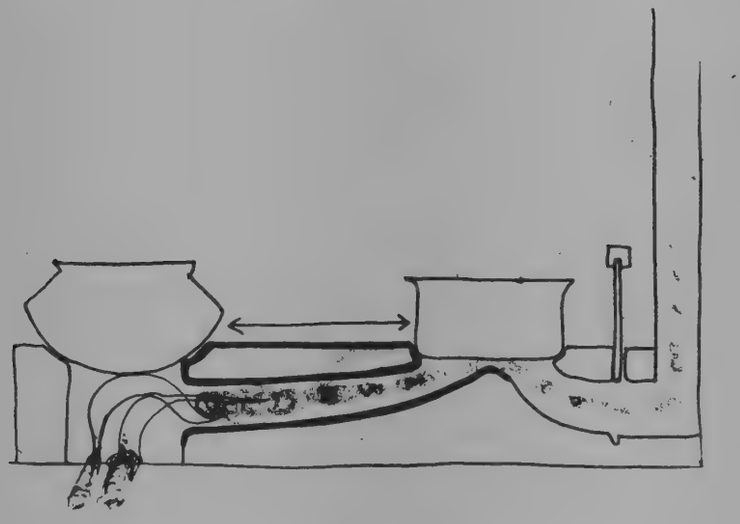
d. Tunnel diameter too small

If the diameter of the tunnel between the first and second holes is too small it can reduce the heat reaching the second hole.

3.2. Gases Not Hot Enough

a. Long distance between cooking holes.

Due to the longer distance hot gases and flames have to move before reaching the second hole, they are not hot enough on reaching it. Unless daily use of big pots makes this necessary, the distance between holes should be reduced by moving the second hole closer to the first.



Helping users solve problems with a new technology is necessary for spreading it successfully.

APPENDIX

A TRAINING COURSE FOR CHULHA MISTRIS

Objective : To train chulha mistris who can build and repair Nada Chulhas and help users learn to use and maintain them properly.

Duration : Minimum 7 days; preferable 10 days. All trainees must be present for the dull duration of the course.

Venue : A village, or a centre near a village where all trainees and instructors can be provided board and lodging for the full duration of the course. Some households in the village should have adopted the Nada Chulha already and another 80 or 100 should be willing to have the chulhas installed by trainees during the course. A community or other building with some open space outside should be available for formal classes and practical work by the trainees. If the course is to be held in an area where no chulhas have yet been built, it will be good to get at least 10 chulhas built in the training village a few weeks before the course starts. This will make it possible for trainees to see reactions of users which is an important part of the course.

Number of trainees : Twenty (maximum).

Trainee profile : Each trainee should have been selected carefully according to the job description for chulha mistris (refer section II, chapter II). Ideally, the trainees should have adopted the Nada Chulha themselves before coming for the course so that they are familiar with using it. They should also have helped mistris or supervisors of their organisations in building one or two. Some familiarity with how the chulha is built will help them take better advantage of the course. Trainees can be village women interested in working as self-employed mistris. In such cases, they should be asked to give an informal commitment to build at least 100 chulhas after training. At least two trainees should be selected from one village. One may not be able to work later or both can work together as a team which many women prefer.

Trainees can also be employees of government or voluntary organisations. Wherever possible, the trainees should have had a few years of schooling.

Resource persons:

1. Course Coordinator

She should be an experienced mistri-cum-supervisor. It will be better if she has also been trained as an instructor or has at least worked as a training assistant on two courses beforehand. The course coordinator will be responsible for dividing trainees into groups and giving tasks to other team members during the course.

2. Training Assistants (two or three)

They should be experienced mistris-cum-supervisors who have already been trained as mistris. They should have an aptitude for training.

3. An experienced village woman chulha mistri She should be extra good at working with mud to teach the trainees how to finish chulhas properly. She should also be witty and able to participate in role play games.

4. One helper (for organising supply and delivery of materials and other odd jobs).

Pre-course organisational arrangements :

1. Selection of 80 to 100 families in whose houses chulhas will be built during the course.

2. Getting the selected families to have enough gara and chaapris ready (for quantities for different types of chulhas, refer chapter V). A number of chaapri moulds should be left with the villagers after they have been shown how to make chaapris.

3. 100 sets of chimneys, dampers and cowls should be taken to the village in advance. (For selecting chimney material and diameters, refer Section I, chapter IV). In areas where chulhas with haras or 3-holed chulhas with 2 tunnels are likely to be popular, more chimney dampers should be arranged as they need 2 chimney dampers each.

4. 20 tool kits for the trainees consisting of:
   - a metal cutter for changing dampers when necessary.
   - a measuring tape.
   - 2 or 3 double edged hacksaw blades for cutting asbestos cement pipes where these are used.
   - a khurpi (only in areas where these are not used for hoeing/ weeding by local people).
   - a mould for making chaapris.

5. Transportation for trainees and resource persons to training village. This will be necessary if they can not be put up within easy walking distance.

6. Board and lodging arrangements for all trainees and resource persons.

7. Enough raw material for making gara. 100 chaapris should also be made in advance. These will be needed for showing how the chulha is built, science teaching experiments and construction practice by trainees.

8. 3 heat resistant glass dishes of 8 to 12 inches diameter.

OUTLINE COURSE CONTENT AND TIME TABLE

DAY	ACTIVITY	VENUE	ARRANGEMENTS REQUIRED
1.	**Morning** — Informal introductions, why each trainee has come for the course; trainees' hopes and aspirations, problems related to cooking in their villages. — (During this session all trainees should be encouraged to talk about how they see women's problems and the course coordinator should try to deal with these during the course).	Centre (either where the trainees are staying or a room in a community building in the village)	
	Tea break — Brief history of the Nada Chulha, role of village women in developing and testing it, advantages of the chulha reported by users, (this can be done through role play between two of the training assistants), how women chulha mistris can spread the technology most effectively (refer chapter II).		
	Afternoon or evening — Chaapri layout for the most suitable chulha type in the training area (refer 3.3, chapter IV and chapter V).	Centre	Blackboard and chalk.
	— Demonstration of chulha construction. (During this, the coordinator and training assistants should demonstrate the construction technique of the Nada Chulha, trainees to be divided into 3 or 4 groups, each group incharge to build a chulha. All trainees should help with making gara).	Centre (practical work site)	Chaapris, gara, chimneys, dampers and utensils for building 3 or 4 chulhas. These properly built chulhas should be kept for use on day 6.
2.	**Morning** — Introduction to tools, materials and how to make chaapris. (Section I, chapter IV). During a brief session, trainees should be shown all tools and materials and reminded of how these were used the previous day The	Centre	Tool kits and samples of all materials used in the chulha.

	importance of making good gara should be stressed and trainees who did not mix it properly on day 1 should be explained how badly made gara will spoil the chulha. Tool kits can be distributed to trainees at this time.		
	Tea break		
	Making gara and chaapris. During this, each trainee should prepare gara separately and make chaapris for one chulha. Trainees should be divided into the same groups as on day 1 and supervised by the same training assistant.	Centre (practical work site)	Pre-soaked clay, chopped straw and/or other additives, chaapri moulds, at least one bucket and mug per group, water.
	Afternoon or evening		
	Different parts of the chulha and how they function. During this session, the trainers should 'show' the effect of chimney draft through demonstration experiments as described in the instructions to trainers in chapter III. Instead of telling trainees what is happening during each experiment, they should be asked to observe the movement of flames and other changes and to point out what has happened each time.	Centre (practical work site)	Demonstration chulhas with detachable parts (ref. instructions, chapter III), heat resistant glass dishes, tin chimney pieces of different diameters.
3.	**Morning**		
	How to plan and build the Nada Chulha step by step. — finding out the users needs — deciding chulha location in the kitchen — planning chaapri layout with the help of most used utensils — building the chulha step by step. (During this session, the coordinator should introduce all the steps in planning and building a chulha as detailed in chapter IV. The importance of going step by step **must** be emphasised. Training assistants and the experienced village woman chulha mistri can be asked to highlight the variation in users' needs and problems created by wrong chulha location through role play).	Centre	Blackboard and chalk.

	Afternoon or evening		
	— Each group to build one chulha each. Training assistants and coordinators should ensure that the trainees proceed step by step. Two or three utensils **must** be made available to each group to help them learn to make chulhas according to sizes of utensils.	Centre (practical work site)	All materials for construction of 3 or 4 chulhas, utensils, etc.
4.	**Morning**		
	— Revision of how to build the chulha step by step. Some trainees should be asked to draw chaapri layout on a blackboard and others to point out if and when a step is missed or a mistake made. The blackboard can be placed on the ground to make it easier for trainees to draw.	Centre	blackboard and chalk.
	— Introduction of check list after completing a chulha (section IV, chapter IV).		
	— Coordinator to point out the most common mistakes in the chulhas built on day 3.		
	— Introduction to building chulhas in village homes, emphasis on sensitivity to users needs, asking to see all commonly used utensils in the kitchen before starting construction, deciding chulha location in an actual kitchen, etc.		
	Late morning onwards		
	— First, checking of chulhas built on day 3 according to the check list introduced in the morning.	Centre (practical work site)	
	— Then, trainees to be divided into 4 groups, each group assigned a supervisor and the work of building 2 chulhas each in village homes. (During this session, trainees to be given close supervision and made to proceed step by step. When the chulhas are completed, the supervisors should check each one by going through the check list and ask trainees to go through the whole list themselves after completing their chulhas).	Village	Advance selection of 8 families, preparation of gara and chaapris by them, delivery of chimneys, dampers and cowls to each house. Transport to and from village (If not within walking distance), packed lunch for everybody.

5.	**Morning**		
	— Revision of how to build the chulha step by step with special emphasis on users' needs and user satisfaction.		Blackboard, chalk, copies of users information sheet.
	— Trainees to draw layouts on blackboard and ask questions about anything they are not sure about or find difficult.		
	— Trainers to give their observations on their group's progress and common errors made by them on day 4.		
	— Introduction to how to use and maintain the chulha and importance of users' education. (refer information sheet for users and chapter VI).		
	Late morning onwards		
	— trainers incharge of each group to decide which trainees can now build a chulha on their own. The weaker trainees can be made to build chulhas in teams of two.	Village	Advance selection of families and all material kept ready in each house.
	— Then 15 to 18 chulhas to be built in village homes during the rest of the day under close supervision. After each chulha is completed, the trainee who built it should be asked to explain proper use and maintenance to the owner and leave an information sheet pasted at a safe but easily visible location in each house.		Transport, copies of users information sheets, and packed lunch.
6.	**Morning**		
	— Discussion of yesterday's experience, trainees to describe any special problems they faced due to users attitudes, their special requirements or the shape of the kitchen or of taking the chimney out of the roof. Coordinator to point out how such problems can be solved.	Centre	blackboard, chalk, users information sheet.
	— Revision of how to use and maintain the chulha properly. Some trainees should be asked to explain use and maintenance to the others.		
	— Introduction of common problems and their solutions through role play and riddles by 2 training assistants. (refer chapter VII).		

Late morning onwards.		
— Lighting a new chulha and cooking practice. This can be done on the four chulhas built on the first day. Each group should cook its lunch on one of the chulhas and practice how to use it properly. If any trainee has questions about special requirements like roasting large rotis in the firebox mouth, that should also be shown during cooking practice.	Practical work site	Utensils and materials required for cooking lunch.
Afternoon or evening		
Practice of chulha repair and solving users problems.	Village	Transport and advance information to owners whose chulhas will be visited.
Each group leader should take the trainees to 3 or 4 houses where Nada Chulhas are already in use, talk to users to find out if they are facing any problems and help solve them. Ideally, some chulhas should need chimney cleaning for trainees to practice that and demonstrate how it should be done to users. If cooking holes of some chulhas have been made too small by users, trainees should be asked to enlarge them by scraping off mud from the edges. They should also explain to users why this should be done. Trainees should also practice how to repair chulhas on chulhas needing repair.		
Late evening		
— Informal mid-course evaluation. If the trainees would like more emphasis given to any aspects or to include something else, the time table of the remaining days can be adjusted to include their suggestions.		
7. Morning		
— Discussion of yesterday's experiences, revision of common problems and their solutions, how some users do not understand proper chulha use and how to help them learn to do so.	Centre	
— Some trainees should do a role play on interaction with users based on yesterday's experiences.		

	— Revision of the importance of proper construction, checking all details before leaving a newly built chulha and relating some of the problems found yesterday to careless construction.		
	Late morning onwards Each group to check all chulhas built by it on day 4 and 5, make minor changes in them where necessary, light small trial fires in the chulhas and demonstrate use of dampers to the owners. Users information sheets should be left pasted in those houses where they have not been delivered so far.	Village	Transport, packed lunch.
8.	**Morning** By this time, most trainees should have a good understanding of how to build chulhas, how to adapt them to users special needs, how to use and maintain them and common problems and their solutions. The whole of day 8 should be devoted to building chulhas in the village. Each trainee **must** build at least one chulha on her own. More confident and enthusiastic trainees will be able to build 2 each. The practice will help them gain self-confidence.	Village	30 to 35 families prepared for having their chulhas built.
9.	**Morning** — Discussion of yesterday's experience and trainees' questions about how to meet special requirements of cooking habits or fuels in their villages. — Coordinator should point out any mistake which some trainees continue to make. — Introduction of design variations for special needs (refer chapter V). The coordinator should explain how the general guidelines for chaapri layout can be used to make a number of design variations. The two or three other chulha types in which the trainees show interest and which are likely to be popular in their villages, should then be built at the practical work site under training assistants' guidance.		

Afternoon or evening

— The importance of leaving chulhas complete in every respect. The coordinator should instruct trainees to to visit **all** the chulhas built during the course on the following day. They should ensure that cowls are fitted properly in all cases; where chimney height is not enough, extra chimney lengths are added; where chimneys pass through thatch roofs, proper insulation is provided between thatch and chimney and that all chulhas have complete damper sets fitted properly.

— The importance of follow up visits to users till they have learnt to use the chulha properly. Trainees should be told that once they start working as chulha mistris, having satisfied users has to be their main goal. For this, they should visit users once soon after the chulha has been put to use, once after a fortnight of this, once after two or three months and once after five to six months of use. By this time, most users will have learnt all important aspects of use and maintenance.

Late evening

— Informal meeting with village women who should include women who have been using Nada Chulhas for some time and those in whose houses chulhas were built during the course. Some of even the second group will have started using their chulhas already. All will be able to talk about their experiences, what advantages or disadvantages they feel the chulha has and what impact the chulha has made on their lives. — Centre or Village

10. **Morning to late afternoon**

Each group should visit all the chulhas built by it during the course, finish any incomplete work, make minor modifications where necessary, light trial fires in chulhas not lit so far, answer users questions and again tell them how to use and maintain the chulha properly. — Village

Evening

Informal session with project directors of organisations who have sent the trainees. The directors should let the trainees know the terms and conditions on which they will be working and paid, what their responsibilities will be, the outline of their organisation's chulha programme and the performance that will be expected from chulha mistris. The support that the organisations will be able to give them, e.g., taking care of getting chimneys and dampers made and delivered to villages, should also be discussed clearly during this session. The trainees should be encouraged to ask any questions that might be worrying them.

Farewell dinner and cultural programme.